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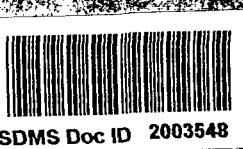

FINAL
INITIAL SITE CHARACTERIZATION REPO
ORDOT LANDFILL
ISLAND OF GUAM

U.S. EPA CONTRACT NO. 68-01-6939

REM II

PERFORMANCE OF REMEDIAL RESPONSE ACTIVITIES AT UNCONTROLLED HAZARDOUS WASTE SITES

U.S. EPA CONTRACT NO. 68-01-6939

CDM Federal Programs Corporation
CAMP DRESSER & McKEE INC.
ROY F. WESTON INC.
WOODWARD-CLYDE CONSULTANTS
CLEMENT ASSOCIATES, INC.
ICF INCORPORATED
C.C. JOHNSON & MALHOTRA, P.C.

FINAL
INITIAL SITE CHARACTERIZATION REPORT
ORDOT LANDFILL
ISLAND OF GUAM

U.S. EPA CONTRACT NO. 68-01-6939
WORK ASSIGNMENT NO. 168-9LA7.2
DOCUMENT CONTROL NO. 279-RI1-RT-FLJV-1

NOVEMBER 18, 1987

Prepared for:

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Irvine, CA 92715

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1.0 SITE HISTORY AND BACKGROUND

1.1 PROJECT BACKGROUND

The U.S. Environmental Protection Agency (USEPA) issued Work Assignment (WA) No. 168-9LA7.0 on August 14, 1985, to Camp Dresser & McKee Inc. (CDM) to conduct a Remedial Investigation (RI) of the Ordot Landfill on the Island of Guam. The objective of the RI was to characterize the landfill with respect to the potential for off-site releases of hazardous constituents. A detailed discussion of the site history and the objectives of the Initial Site Characterization (ISC) are presented in Sections 1.2 and 1.3, respectively.

After receipt of the WA, CDM conducted an Initial Site Inspection on October 17, 1985. The inspection included a site visit and meetings with the Guam Environmental Protection Agency (GEPA), the Water and Energy Research Institute (WERI) of the University of Guam; and the U.S. Geological Survey (USGS). The results of the Initial Site Inspection were that studies currently underway were insufficient in scope to adequately address the potential for off-site release of contamination. Furthermore, the existing database was not of sufficient detail to perform an accurate assessment of the site. As such, CDM began preparing the necessary documents to conduct an ISC. The following documents have been prepared in support of this effort:

1. Revised Work Plan Memorandum for Ordot Landfill, Island of Guam, dated November 20, 1985 (Doc. Control No. 279-WP1-WM-BKXD-3).

2. Work Plan, Ordot Landfill, Guam - Remedial Investigation, dated June 2, 1986 (Doc. Control No. 279-WP1-WP-CQFJ-1).

3. Final Sampling and Analysis Plan - Phase I Remedial Investigation, Ordot Landfill, Guam, dated February 2, 1987 (Doc. Control No. 279-RI1-OP-DXFL-1).

4. Final Quality Assurance Project Plan - Remedial Investigation, Ordot Landfill site, Guam, dated February 10, 1987 (Doc. Control No. 279-WP1-OP-DXRS-1)

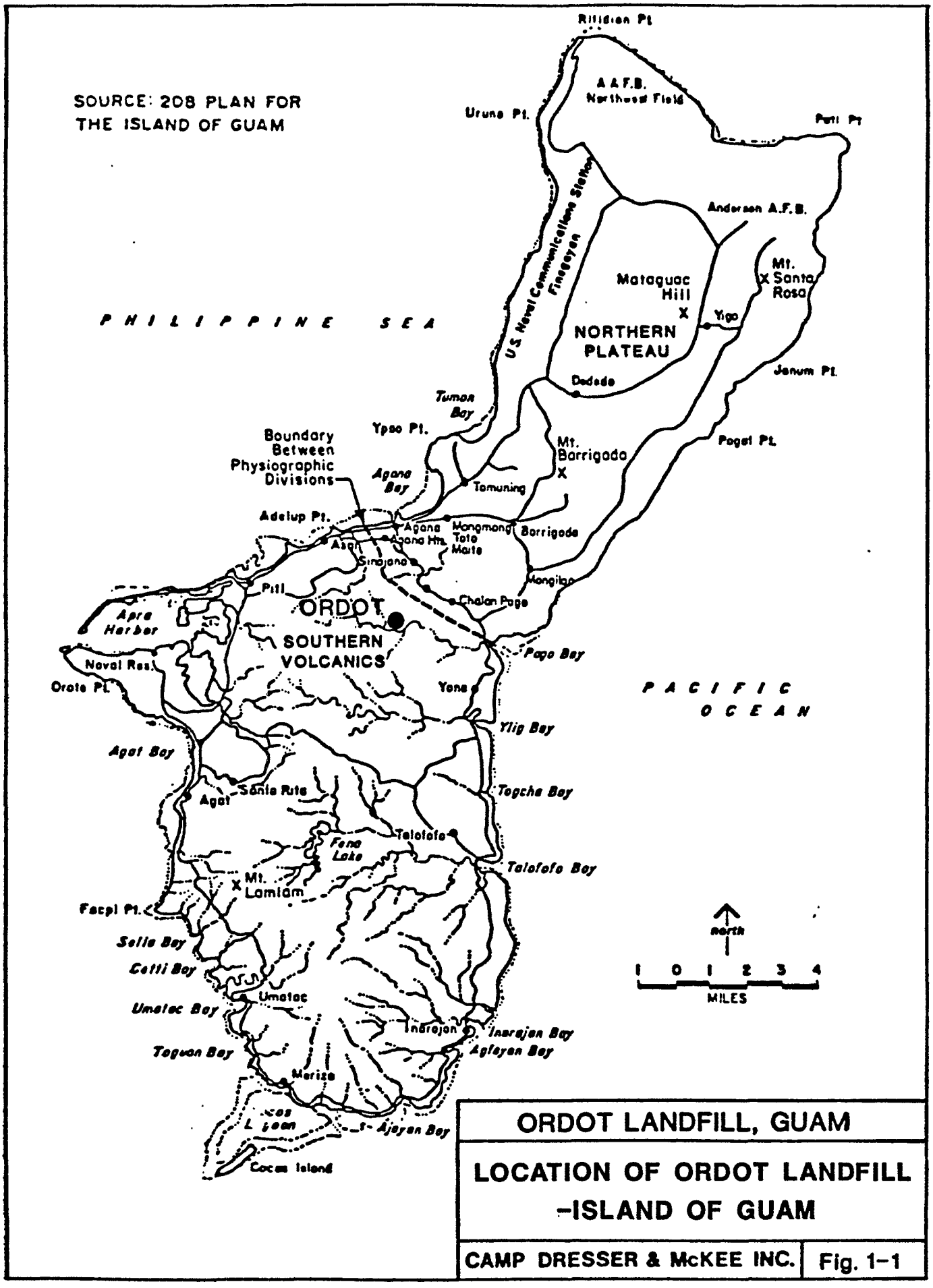
The ISC sampling activities were conducted from March 10 through March 16, 1987. A description of these activities is included in sections of this report. The data from the sampling activities is also presented and discussed. However, it should be pointed out that the data collected as a part of this investigation may not full characterize the site due to the following reasons: (1) There are extreme seasonal fluctuations on the island and the data was collected during the dry season, and (2) Additional sampling will be required to accurately characterize the seasonal fluctuations at the site.

This report represents the final deliverable under this REM II work assignment. Currently, the Risk Assessment (RA) is in draft form and has undergone internal review by ICF/Clements, a subcontractor firm of the REM II team. However, the draft will be finalized under a REM IV work assignment.

1.2 SITE HISTORY

The Island of Guam is located in the western Pacific region, approximately half-way between Japan and New Guinea, and is the largest island in the Mariana Island Group. Guam has an area of about 212 square miles, is approximately 30 miles long, and ranges between 4 and 11.5 miles wide (Figure 1-1). The island has two very distinct physiographic divisions. The southern half is composed of rugged volcanic upland and the northern half of the island is characterized by a limestone plateau. The majority of Guam's drinking water supply comes from groundwater produced from the sole-source limestone aquifer in the northern part of the island.

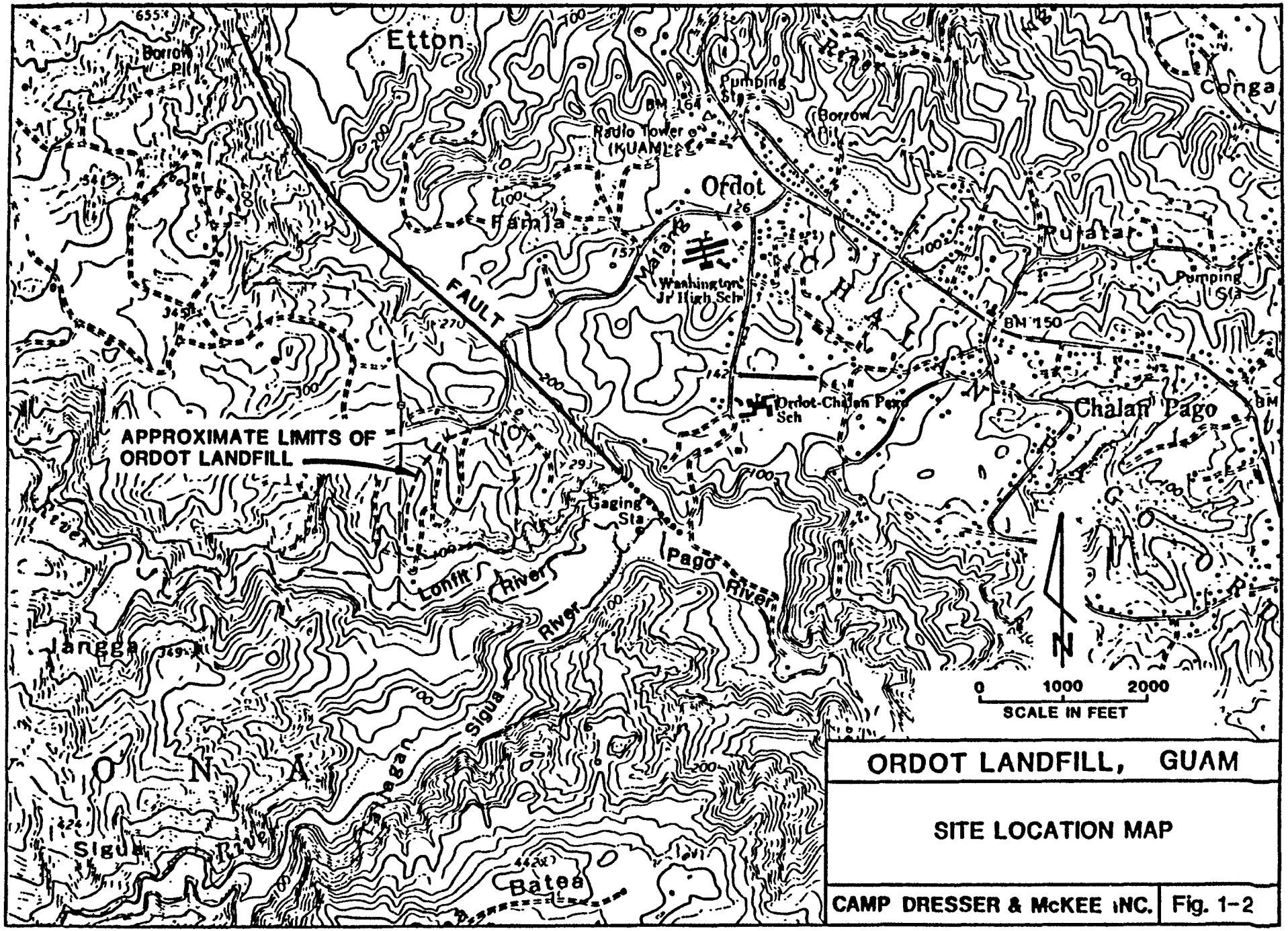
The Ordot landfill is located in the northern part of the volcanic upland area, near the divide between the limestone and volcanic provinces (Figure 1-2). This divide is thought to consist of a fault (Tracey, et al. 1964). However, the exact demarcation between the two geologic units is not well defined.



ORDOT LANDFILL, GUAM

LOCATION OF ORDOT LANDFILL -ISLAND OF GUAM

CAMP DRESSER & McKEE INC. | Fig. 1-1



ORDOT LANDFILL, GUAM

SITE LOCATION MAP

CAMP DRESSER & McKEE INC. | Fig. 1-2

The landfill receives the majority of the wastes generated on the island and was designed and operated as a municipal landfill. However, the landfill is known to have received hazardous wastes during its history, which dates back to the Japanese occupation during World War II. The site is known to have received PCB contaminated oils from transformers, munitions, and hazardous wastes commonly used in households and light industry. However, records do not exist regarding when, how much, and what type of hazardous wastes were disposed of at the landfill.

Uncontrolled disposal of hazardous and other wastes at the Ordot Landfill has resulted in several problems, including uncontrolled surface water run-on and run-off from the site. The uncontrolled surface water run-on has resulted in leachate emanating from various locations around the landfill. This leachate leaves the landfill site in the form of small springs or streams and eventually enters the Lonfit River (Figure 1-2). The leachate that discharges to the river eventually enters Pago Bay on the east side of the island, where fish kills have been reported. Contamination of marine life and recreational areas in Pago Bay are considered to be potential public health problems.

An additional possible public health problem due to the Ordot Landfill is the potential contamination of the sole-source aquifer in the area. As previously described, the Ordot Landfill is thought to be located in the southern physiographic province where volcanic bedrock exists. However, due to the proximity of the landfill to the limestone unit, there is some concern that there is a potential for contaminating the limestone aquifer. There is also some concern that a portion of the landfill may directly overlay the limestone aquifer, in which case there would be a definite public health problem.

In addition to hydrologic concerns, there has historically been an air quality problem due to noxious odors, caused in part by the presence of dead animals. These noxious odor problems are further compounded by the uncovered municipal waste present at the site. An additional concern at the landfill consists of the methane gas generated by the decomposing waste. Much of the gas is vented to the atmosphere, although subterranean

fires have occurred several times during the history of the site. The presence of gas may represent a public health problem to individuals working on or near the site.

1.3 OBJECTIVE OF INVESTIGATION

The primary objectives of the ISC were to: (1) determine if contaminants are present at the site and migrating off site; (2) identify specific contaminants; and (3) identify contaminant concentrations, quantities, and physical states. In order to meet these objectives, the following activities were performed at the site:

1. Determine the quality of leachate leaving the boundaries of the landfill;
2. Determine the water quality in the Lonfit River, both upstream and downstream of the landfill;
3. Determine the water quality of the groundwater in the limestone aquifer in the vicinity of the town of Ordot;
4. Perform a reconnaissance-level geologic investigation in the vicinity of the landfill in order to identify the bedrock unit underlying the landfill; and
5. Perform a reconnaissance-level air quality survey to portray field conditions.

The data collected from these activities are presented and discussed in the later sections of this report. The data discussion includes a preliminary assessment of the level of contamination at the site and the potential pathways. Recommendations for additional studies are also presented. Finally, potential preliminary mitigative measures to be considered to reduce the potential for off-site releases of contamination are also discussed.

2.0 FIELD PROGRAM

The field program was conducted during March 10 - 16, 1987. The program included various sampling activities, and geologic mapping. In addition, interviews were conducted in support of the Risk Assessment (RA). Each of these activities are individually discussed below.

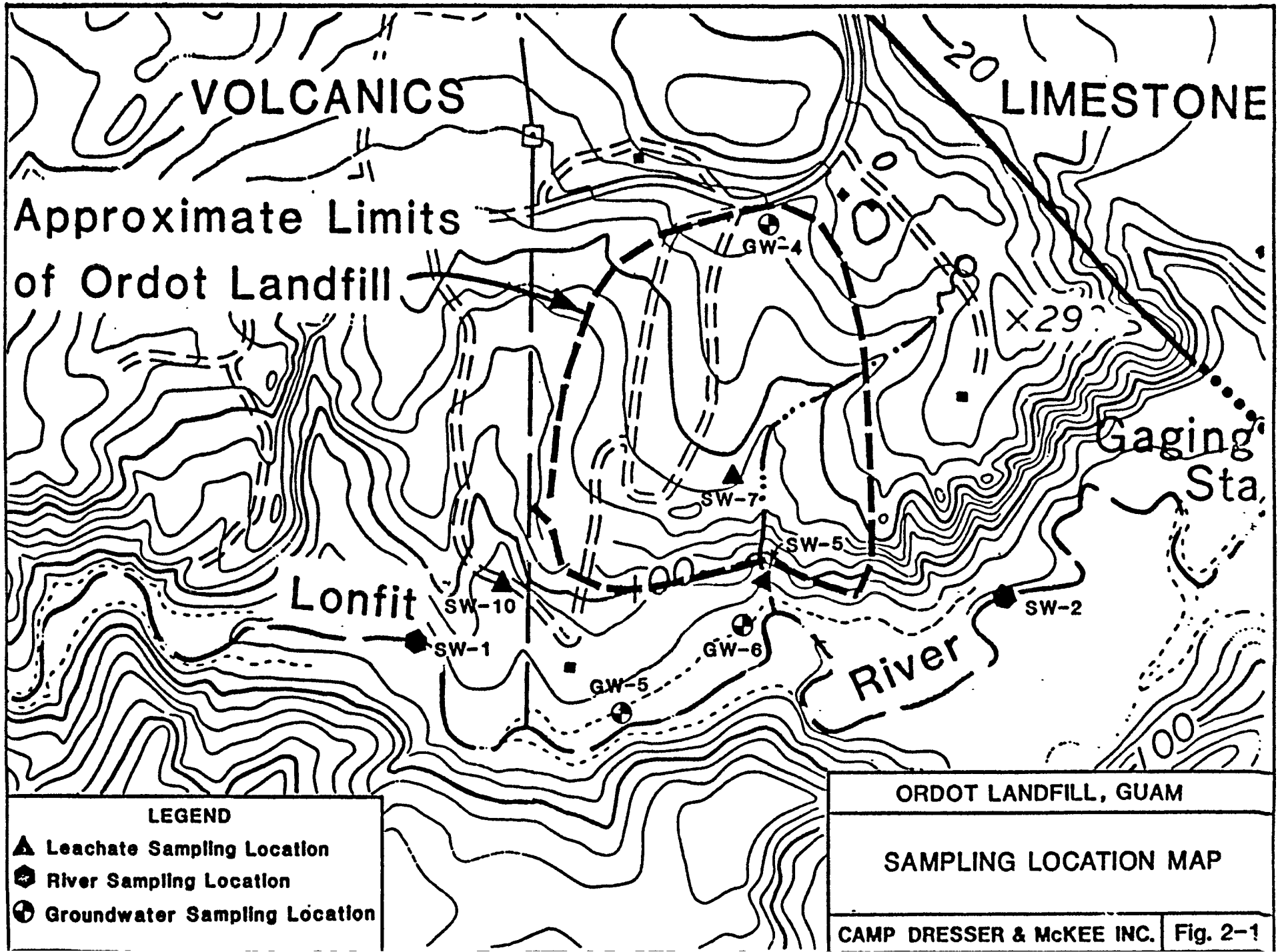
2.1 SAMPLING ACTIVITIES

In order to evaluate the potential for the off-site release of contaminants from the landfill, an extensive sampling effort was performed. This effort included surface water; leachate; on- and off-site groundwater; and qualitative air sampling. Each of these activities are individually discussed below. In addition, sections are presented which provide a discussion of the sample documentation and quality assurance/quality control (QA/QC) procedures conducted during the field investigation.

2.1.1 SURFACE WATER SAMPLING

The surface water sampling was performed to evaluate the potential impact of the landfill emissions on the Lonfit River. To address this impact, the river was sampled both upstream and downstream of the landfill. The samples were analyzed for Routine Analytical Services (RAS) volatiles, semi-volatiles, pesticides/PCBs, and inorganics. The locations of these sampling stations are shown on Figure 2-1.

The surface water samples were collected using grab sampling techniques. The method involves collecting the sample in a large container and then aliquoting the sample into the proper containers. Although the aliquoting process may have lead to the loss of volatiles, the sampling team felt that it was more important to collect a representative sample at that point of time, rather than collecting samples in the individual containers over a period of time due to the river flow.


VOLCANICS
LIMESTONE
Approximate Limits
of Ordot Landfill
GW-4
GW-5
GW-6
SW-1
SW-2
SW-5
SW-7
SW-10
Lonfit
River
Gaging
Sta
LEGEND
Leachate Sampling Location
River Sampling Location
Groundwater Sampling Location
ORDOT LANDFILL, GUAM
SAMPLING LOCATION MAP
CAMP DRESSER & McKEE INC.
Fig. 2-1

Due to the nature of the water course, it was necessary to wade into the Lonfit River to collect the samples. To eliminate the collection of sediments, the downstream sample SW-2 was initially collected. In addition, the sampling point was approached from downstream to avoid unnecessary agitation of the stream bottom. Following the collection of sample SW-2, the sampling team collected sample SW-1 from the Lonfit River upstream of the landfill. The same sample collection procedures were utilized at site SW-1 to minimize disturbance of the stream sediments.

Immediately following sample collection, field water quality parameters were measured using portable field instruments. The parameters determined in the field included pH, temperature, conductivity, and dissolved oxygen. The results of these measurements are presented in Table 2-1.

2.1.2. LEACHATE SAMPLING

Three samples were collected from leachate emanating from the landfill. In the Sampling and Analysis Plan (SAP) for the field program, it was originally proposed that up to eight samples were to be collected. The proposed sample locations were based on observations made during the initial site inspection conducted in October, 1985, which coincided with the wet season on Guam. However, several of the proposed leachate sampling locations were not flowing since the sampling was conducted in March during the dry season.

The locations of the leachate sampling points are shown in Figure 2-1. Sample location SW-05 was collected from a leachate spring emanating from the south side of the landfill. This spring was estimated to be flowing at a rate of approximately five to six gallons per minute (gpm). Leachate sample SW-10 was collected from a smaller spring flowing from the west side of the landfill. Finally, sample SW-07 was collected from a leachate pond area located along the south toe of the landfill. All samples were analyzed for RAS inorganics and pesticide/PCBs.

Table 2-1: Field Water Quality Parameters for Surface Water and Leachate Samples

Sample Number	Description	Date	Time	Dissolved Oxygen (ppm)	pH (units)	Conductivity (μmhos/cm)	Temperature (°C)
SW-01	Lonfit River, upstream of landfill	3/12/87	1646	7.95	7.96	360	26.0
SW-02	Lonfit River, downstream of landfill	3/12/87	1515	6.85	7.98	370	24.5
SW-05	Leachate spring, south side of landfill	3/12/87	1550	6.20	7.84	1420	25.5
SW-07	Leachate pond area, south side of landfill	3/13/87	1620	—	—	—	—
SW-10	Leachate stream, west	3/14/87	1430	2.75	7.65	1225	28

The sample collection procedures for the leachate springs were identical to the surface water samples. For example, the samples were initially collected in a large container and later aliquoted into the proper sample containers. Due to the low flows of the springs, the large five-gallon sample container could be lowered directly into the leachate stream without wading into the water course.

The sample collected from the pond area involved digging a ditch to allow enough leachate to accumulate. After enough volume accumulated, the large sample container was used to collect the sample. The sample was then aliquoted into the appropriate containers.

Following the collection of the leachate samples, the field parameters were determined with portable instruments. The results of the field measurements are presented in Table 2-1. It should be noted that the conductivity measured for the leachate springs was very elevated when compared to the Lonfit River. This indicates that the leachate emanating from the landfill has a higher dissolved solids content than the river and suggests the leaching of metals from the landfill due to the poor drainage control practiced at the landfill.

2.1.3 GROUNDWATER SAMPLING

Five groundwater samples were collected to evaluate the potential for leachate to infiltrate and contaminate the groundwater resources in the area. Two of the samples were collected from municipal wells located north of the landfill in the limestone (Figure 2-2). Three additional samples were collected from on-site monitoring wells located in the volcanic province (Figure 2-1). The on-site wells were installed by the Water and Energy Research Institute (WERI). A summary of the information for each well sampled is provided in Table 2-2. The samples were analyzed for RAS volatile, semi-volatile, inorganics, and pesticide/PCBs.

The sampling procedure for the on-site monitoring wells included the evacuation of the well until the field parameters stabilized or until the well was dry. The field parameters measured during the evacuation included

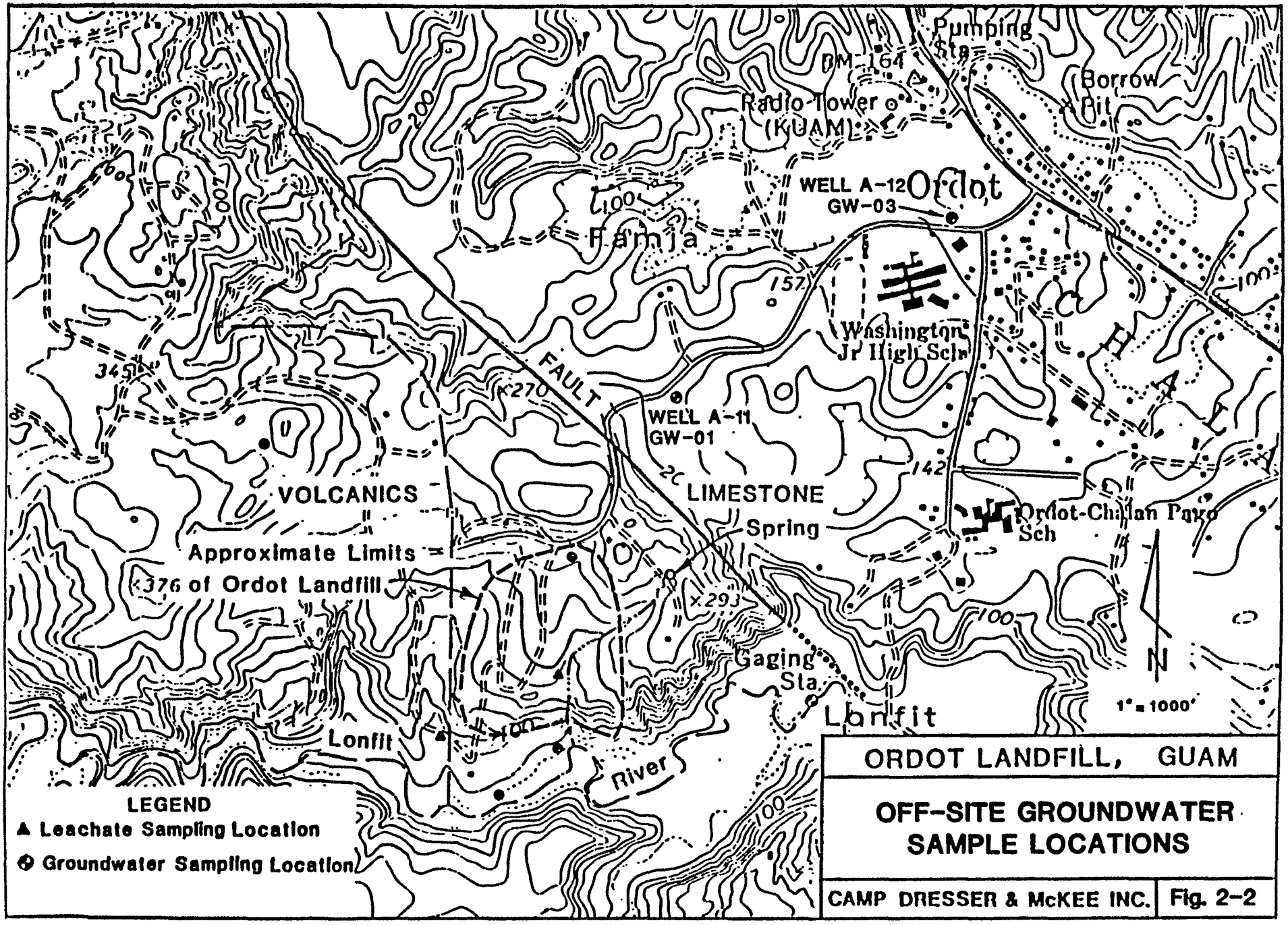
Table 2-2. Summary of Well Information

Sample No.	Description	Suspected Completion Interval	Total Depth (ft.)	Screened Interval	Well Material
GW-01	Municipal Well A-11	Agara Member of the Mariana Limestone	330	120-330	Stainless Steel
GW-03	Municipal Well A-12	Agara Member of the Mariana Limestone	328	225-328	Stainless Steel
GW-04	WERI Background Monitoring Well	Aluton Formation	58	Open Hole	2-inch PVC, sch. 40
GW-05	WERI Downgradient Monitoring Well	Aluton Formation/Lonfit River alluvium	60.5	Open Hole	2-inch PVC, sch. 40
GW-06	WERI Well #4 Downgradient	Aluton Formation/Lonfit River alluvium	26	Open Hole	2-inch PVC, sch. 40

TABLE 2-3

DATA COLLECTED DURING PRE-SAMPLING PURGING

Sample Number	Date	Time	Data Collected: Volume Withdrawn	Conductivity (μmhos/cm)	Temperature (°C)	pH (units)	Notes
GW-04 (WERI upgradient well)	3/13/87	1405	2.5 gal	408	27	7.30	
		1408	4.0 gal	407	26	7.28	
		1416	5.0 gal	410	26	7.26	Bailed Dry
GW-05 (WERI downgradient well)	3/13/87	1740	.25 gal	710	28	6.43	
		1748	2.25 gal	700	24.5	6.35	
		1750	3.0 gal	700	24	6.27	Collect Sample
GW-06 (WERI well #4 - downgradient)	3/13/87	1618	.25 gal	1400	14	6.60	
		1620	.72 gal	1400	13	6.66	
		1624	1.25 gal	1380	12	6.80	Bailed Dry
GW-01 (Municipal Well A-11)	3/12/87	1415	___	810	28.4	6.75	Active Well - Not Purged
GW-03 (Municipal Well A-12)	3/12/87	1500	___	800	26.6	6.71	Active Well - Not Purged


Pumping Sta
BM-164
Borrow Pit
Radio Tower (KUAM)
WELL A-12
GW-03
Ordot
Farmja
152
Washington Jr High Sch
FAULT
WELL A-11
GW-01
VOLCANICS
LIMESTONE
Spring
Ordot-Chalan Pago Sch
Approximate Limits of Ordot Landfill
Gaging Sta
Lonfit
Lonfit
River
N
1" = 1000'
LEGEND
▲ Leachate Sampling Location
Groundwater Sampling Location
ORDOT LANDFILL, GUAM
OFF-SITE GROUNDWATER SAMPLE LOCATIONS
CAMP DRESSER & McKEE INC.
Fig. 2-2

conductivity, pH, and temperature. The casing evacuation was accomplished using a Teflon bailer. The data collected during the purging are presented in Table 2-3.

Samples from the municipal wells were collected using the in-place pump. The sample containers were filled directly from the access ports present on the well heads. Since these wells are actively used, pre-sampling purging was not required. The field parameters were measured for each well, the results of which are presented in Table 2-3.

Following the evacuation of the on-site monitoring wells, the sample was collected. In some instances, the well was evacuated to dryness and the field team had to allow the well to recover prior to sample collection. The sample was collected using a Teflon bailer. The bailer was lowered to just above the bottom of the well and allowed to fill. Upon withdrawal of the bailer, the sample bottles were filled directly from the bailer. The first containers filled were for volatile organic analysis. Care was taken not to agitate or aerate the water while pouring from the bailer.

A bailer was not used to collect the samples from the municipal wells because no access was available to the well casings. In these cases, samples were collected directly from the well head using an access port on the discharge line. As with the monitoring wells, care was taken to assure against the unnecessary agitation or aeration of the sample. In addition, the volatile organic samples were intially collected, followed by the semi-volatile and pesticide/PCB samples.

The samples collected for metals analysis could not be filtered and preserved in the field since a critical part of the portable peristaltic pump was not shipped to Guam. In order to follow proper preservation protocols, the samples were immediately taken to the Guam EPA laboratory for filtration using a .45 micron filter. Following filtration, the metals samples were preserved with nitric acid to a pH of less than 2. Since these samples were immediately filtered at the laboratory, there will be no impact on the analytical results.

2.1.4 AIR QUALITY SAMPLING

Noxious odors have historically been a problem at the Ordot landfill. In addition, subterranean fires have occurred in the past, which indicates the potential for flammable gas production within the landfill. In order to provide some qualitative data on the air quality at the site, the sampling personnel performed a reconnaissance-level air survey utilizing field instruments.

The air survey involved performing several transects across the landfill and taking measurements with field instruments. A survey was performed on each of the three days that the sampling team was on site. The following field instruments were included in the survey: Century Portable Organic Vapor Analyzer (OVA), HNu Photoionization Detector, GCA MINIRAM Particulate/Aerosol Monitor, Gastechtor Hydrocarbon Surveyor, Monitox H_2S Meter, and a Ludlum Radiological Survey Meter.

The instruments were in continuous operation while the field crew slowly walked each transect. The average response for each instrument along the transect was documented in the field logbook. Occasionally, the field team encountered an area along the transect where elevated instrument responses were observed. These areas were marked on the map and the responses recorded in the field logbook. A summary of the average responses for each transect, as well as the areas where elevated instrument responses were observed, is provided in Table 2-4. The locations of the transects for each day the air survey was performed are provided on Figures 2-3, 2-4, and 2-5.

2.1.5 DOCUMENTATION

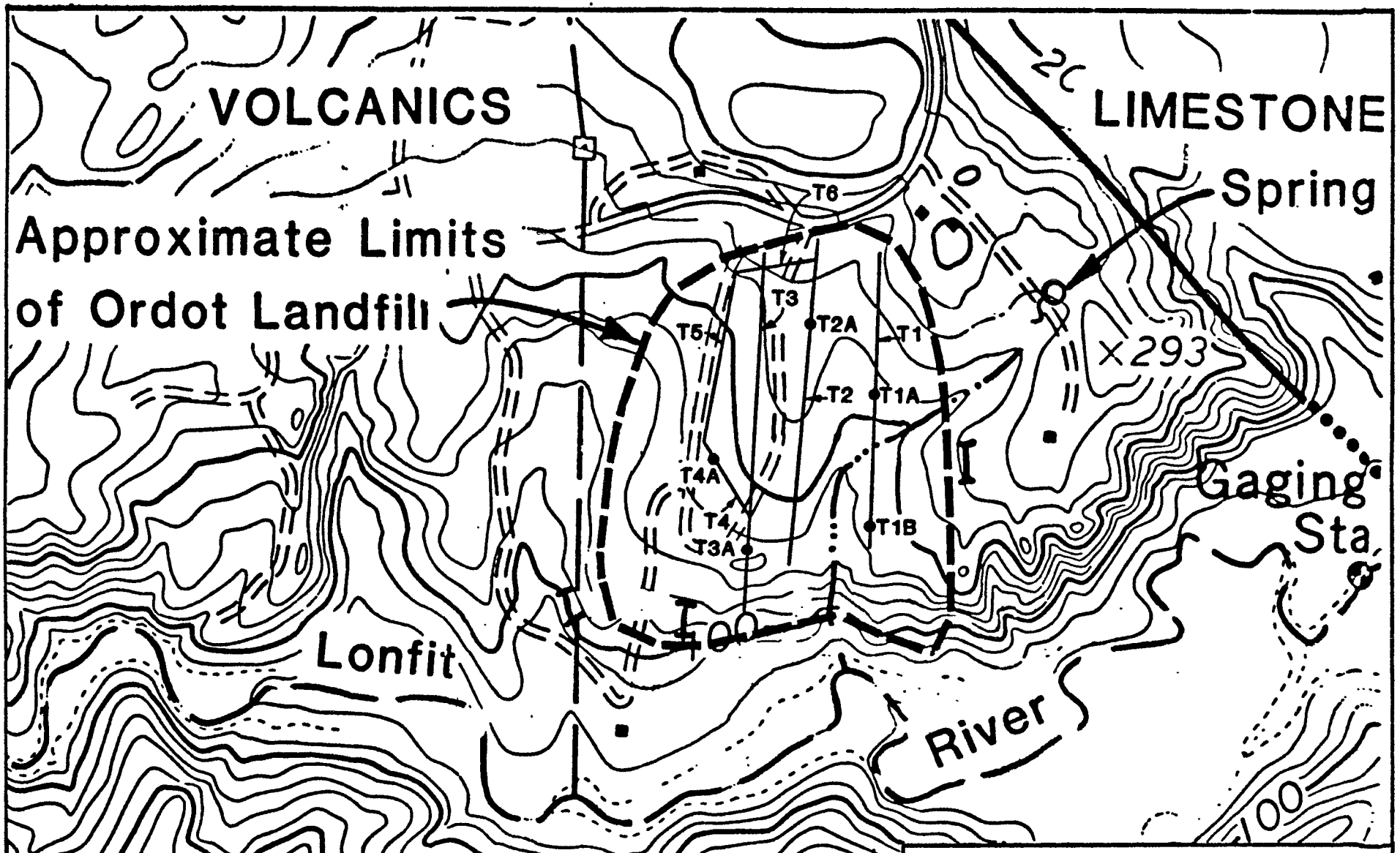
All of the field activities were documented in a bound, water-resistant log book. The activities documented included date, time, personnel on site, sample description, number of sample containers, etc. The log book was maintained by the On-Site Coordinator (OSC). All entries were made with

Table 2-4. Summary of Air Quality Data

Date	Transect No.	Average Instrument Response Along Transect	Elevated Instrument Response(s) Location	Response
3/13/87	Background	OVA: 0 ppm HNu: 0.9 ppm Rad: Gamma - 100 cpm Alpha - 1 cpm H_2S: 0 MINIRAM: 0 Gastechtor: Oxygen - 21% Hydrocarbons - 0		
3/13/87	T_1	All Instruments: 0	T_{1A} T_{1B}	OVA: 2-4 ppm OVA: 9-20 ppm HNu: 1.1 ppm MINIRAM: 4.03 mg/m^3
3/13/87	T_2	OVA: 6-7 ppm All Other Instruments: 0	T_{2A}	OVA: 9-24 ppm MINIRAM: 3.77 mg/m^3
3/13/87	T_3	OVA: 5 ppm All Other Instruments: 0	T_{3A}	OVA: 5-90 ppm MINIRAM: 3.0 mg/m^3
3/13/87	T_4	OVA: 6 ppm All Other Instruments: 0	T_{4A}	OVA: 6-70 ppm MINIRAM: 0.16 mg/m^3
3/13/87	T_5	OVA: 6-7 ppm All Other Instruments: 0	None	
3/13/87	T_6	All Instruments: 0	None	
3/14/87	Background	OVA: 0 ppm HNu: 0 ppm H_2S: 0 Gastechtor: Oxygen - 21% Hydrocarbons - 0 MINIRAM: Inoperable Rad: Not used		
3/14/87	T_1	OVA: 2 ppm All Other Instruments: 0	None	
3/14/87	T_2	OVA: 5-6 ppm All Other Instruments: 0	T_{2A}	OVA: 10-20 ppm
3/14/87	T_3	OVA: 1-2 ppm All Other Instruments: 0	T_{3A}	OVA: 2-70 ppm
3/14/87	T_4	OVA: 1-2 ppm All Other Instruments: 0	None	

Table 2-4, continued

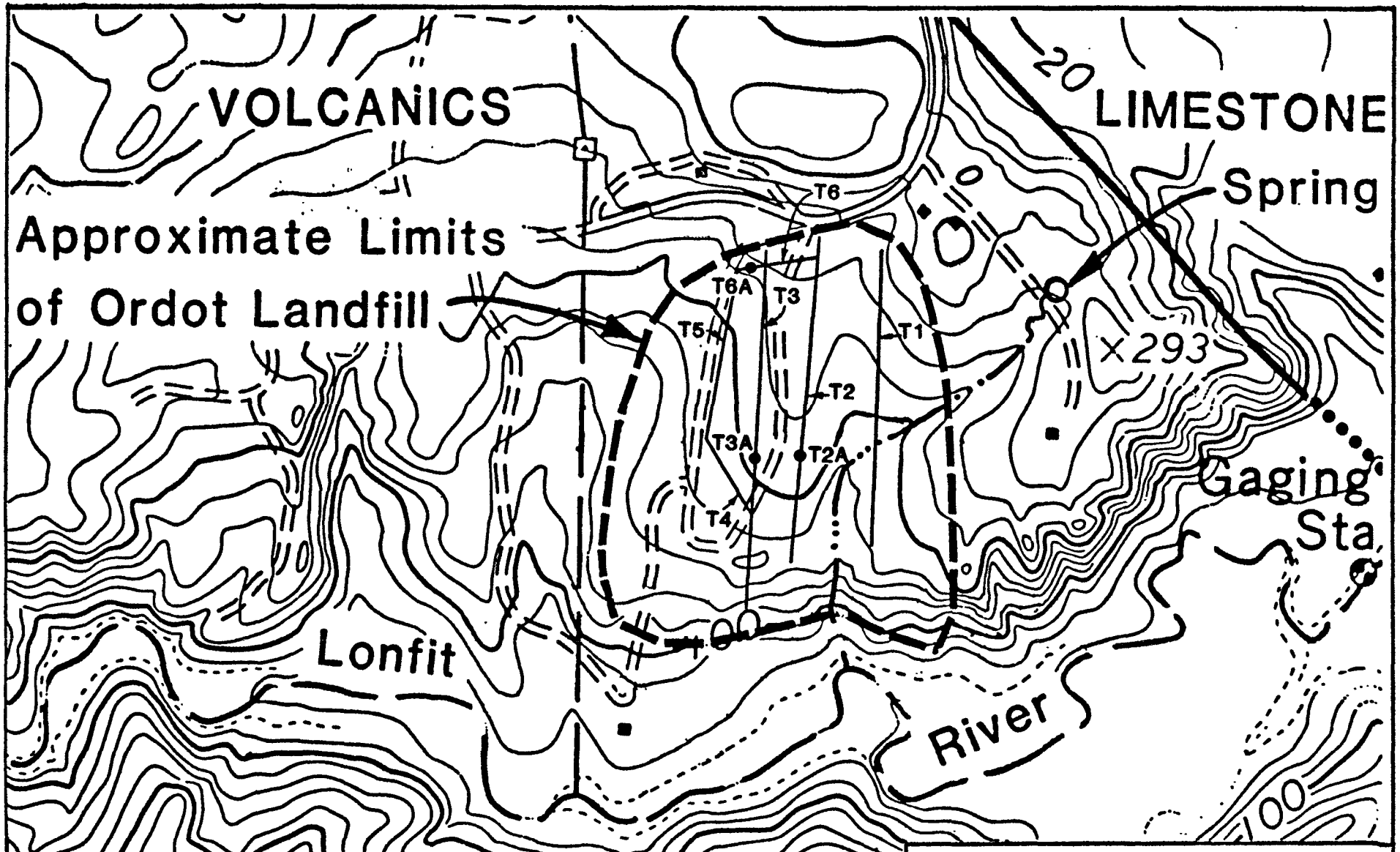
Date	Transect No.	Average Instrument Response Along Transect	Elevated Instrument Response(s) Location	Response
3/14/87	T_5	OVA: 1-2 ppm All Other Instruments: 0	None	
3/14/87	T_6	OVA: 1-2 ppm All Other Instruments: 0	T_{6A}	OVA: 10-20 ppm
3/15/87	Background	OVA: 0 ppm HNu: 0.2 ppm Gastechtor: Oxygen - 21% Hydrocarbons - 0 H2S: 0 MINIRAM: Inoperable Rad: Not used		
3/15/87	T_1	OVA: 4-5 ppm All Other Instruments: 0	T_{1A}	OVA: 10-20 ppm
3/15/87	T_2	OVA: 4 ppm All Other Instruments: 0	T_{2A}	OVA: 10 ppm
3/15/87	T_3	OVA: 2-3 ppm All Other Instruments: 0	T_{3A} T_{3B}	OVA: 10-20 ppm OVA: 40-90 ppm
3/15/87	T_4	OVA: 5 ppm All Other Instruments: 0	None	
3/15/87	T_5	OVA: 5 ppm All Other Instruments: 0	None	
3/15/87	T_6	OVA: 4 ppm All Other Instruments: 0	T_{6A}	OVA: 80-100 ppm



ORDOT LANDFILL, GUAM

AIR SAMPLING TRANSECTS
FOR MARCH 13, 1987

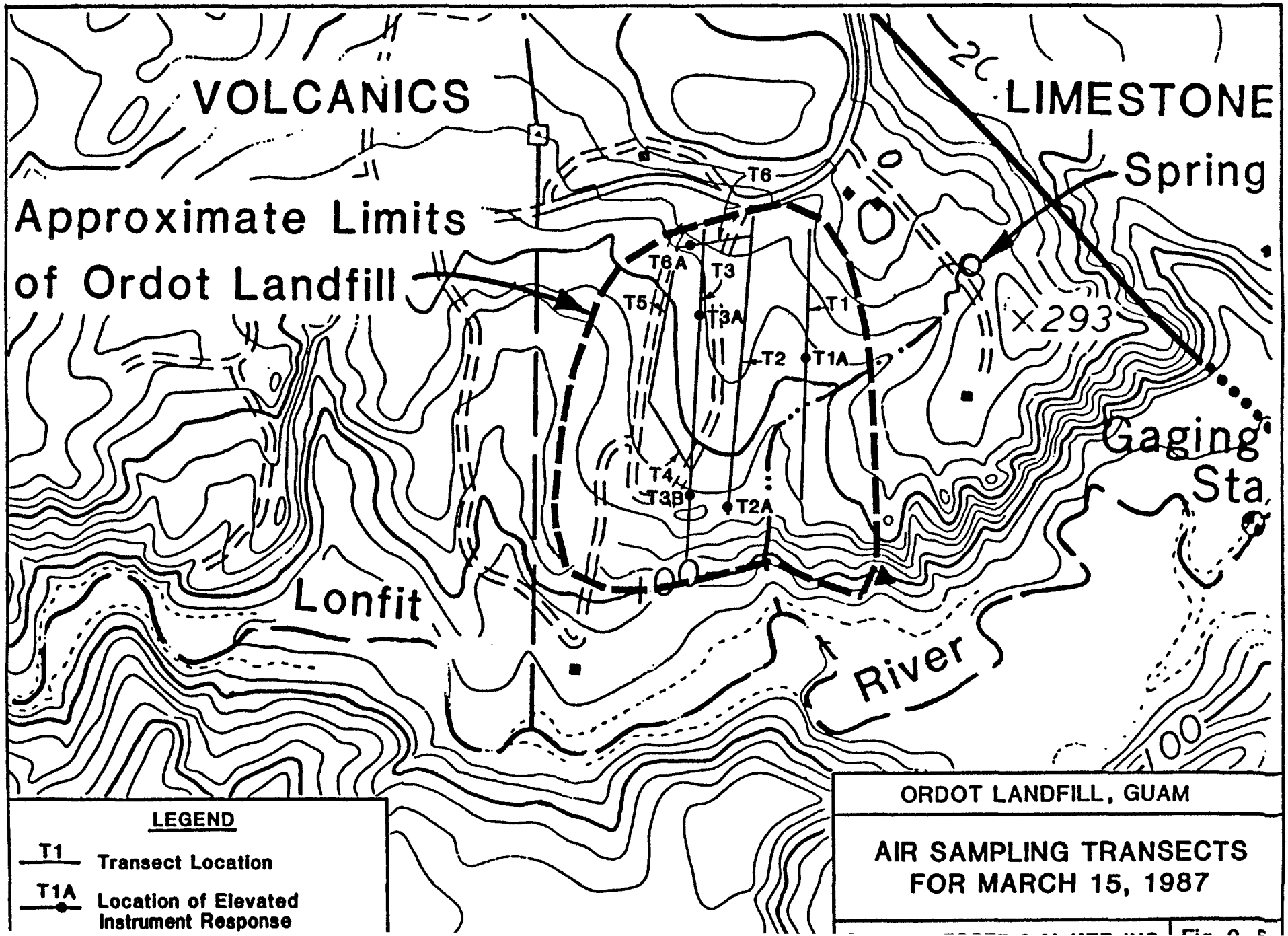
CAMP DRESSER & McKEE INC. | Fig. 2-3



ORDOT LANDFILL, GUAM

AIR SAMPLING TRANSECTS
FOR MARCH 14, 1987

CAMP DRESSER & McKEE INC. | Fig. 2-4


VOLCANICS
LIMESTONE
Spring
Approximate Limits
of Ordot Landfill
T6
T6A
T3
T5
T3A
T1
T2
T1A
T4
T3B
T2A
×293
Gaging
Sta
Lonfit
River
LEGEND
T1 Transect Location
T1A Location of Elevated Instrument Response
ORDOT LANDFILL, GUAM
AIR SAMPLING TRANSECTS
FOR MARCH 15, 1987

permanent black ink, with each person making a entry on a particular page signing the bottom of the page. All incorrect entries were crossed out with a single strike mark and initialled.

The appropriate CLP documentation was also completed during the field effort. The documentation included both RAS organic and inorganic traffic reports for each sample shipped. In addition, proper chain-of-custody (COC) protocol was followed during the course of the field work. This protocol included completing the U.S. EPA Region IX serialized COC forms for each sample shipment. These forms then accompanied the shipment to the CLP laboratory to assure proper documentation of sample transfer. An inventory of the traffic reports, COC numbers, and corresponding sample identification is provided in Table 2-5.

2.1.6 QUALITY ASSURANCE AND QUALITY CONTROL PROCEDURES

The Quality Assurance/Quality Control (QA/QC) program in effect while conducting the field activities included the following:

- Proper equipment decontamination according to established procedures;
- Use of sample containers provided by the Superfund Sample Bottle Repository Program;
- Complete documentation of activities in field log books;
- Use of duplicate samples and travel blanks;
- Following proper COC protocol including use of COC forms and seals.

The equipment decontamination involved an initial rinse with tap water, followed by a nitric acid wash, and final triple rinse with HPLC water. The equipment decontaminated in this fashion included the large sample containers used to collect the leachate and surface water samples, as well as the bailer used to collect the groundwater samples. Furthermore, the bailer line was disposed of between samples.

TABLE 2-5

SAMPLE INVENTORY
GROUNDWATER (GW) SAMPLES AND SURFACE WATER (SW) SAMPLES

CDM Sample No.	Date (1987) Sampled (MM-DD)	Date (1987) Shipped (MM-DD)	Time Sampled	Inorganic Traffic Report (ITR) ITR Sample No.	Inorganic Traffic Report (ITR) COC No.	Organic Traffic Report (OTR) OTR Sample No.	Organic Traffic Report (OTR) COC No.	Location Information	Duplicate Samples
GW-01	03-12	03-12	1500	MY-0190	9-4391	Y-4965	9-4391	Municipal Well A-11	Dup. of GW-02
GW-02	"	"	1445	MY-0191	"	YB-199	"	Municipal Well A-11	Dup. of GW-01
GW-03	"	"	1415	MY-2100	"	Y-4958	"	Municipal Well A-12	
SW-01	"	"	1646	MY-2095	9-4390	Y-4953	9-4390	Lonfit River, upstream of landfill	
SW-02	"	"	1515	MY-2096	"	Y-4954	"	Lonfit River, downstream of landfill	Dup. of SW-13
SW-05	"	"	1550	MY-2099	9-4389	Y-4957	9-4389	Leachate spring, south side of landfill	
SW-13	"	"	1535	MY-0192	"	YB-196	"	Lonfit river, downstream of landfill	Dup. of SW-02
TB-01	"	"	—	-NA-	-NA-	YB-200	9-4391	Travel blank	
TB-02	"	"		-NA-	-NA-	Y-4795	9-4389	Travel blank	
GW-04	03-13	03-16	1417	MY-2097	9-4393	Y-4955	9-4392 & 3	WERI background well	
GW-05	"	"	1750	MY-2098	9-4392	Y-4956	9-4392	WERI well, south side of pond	
GW-06	"	"	1515	MY-0790	"	Y-4960	"	WERI well 4	Dup. of GW-07
GW-07	"	"	1624	MY-0791	"	Y-4961	"	WERI well 4	Dup. of GW-06
SW-07	"	"	1620	MY-0789	9-4393	Y-4959	9-4392 & 3	Leachate pond area, south side of landfill	
TB-03	"	"		-NA-	-NA-	Y-4964	9-4392	Travel blank	
SW-10	03-14	"	1430	MY-0187	9-4393	Y-4962	9-4392 & 3	Leachate stream, west side of landfill	

NA - Not applicable, Travel Blanks (TB) shipped only with organic samples.

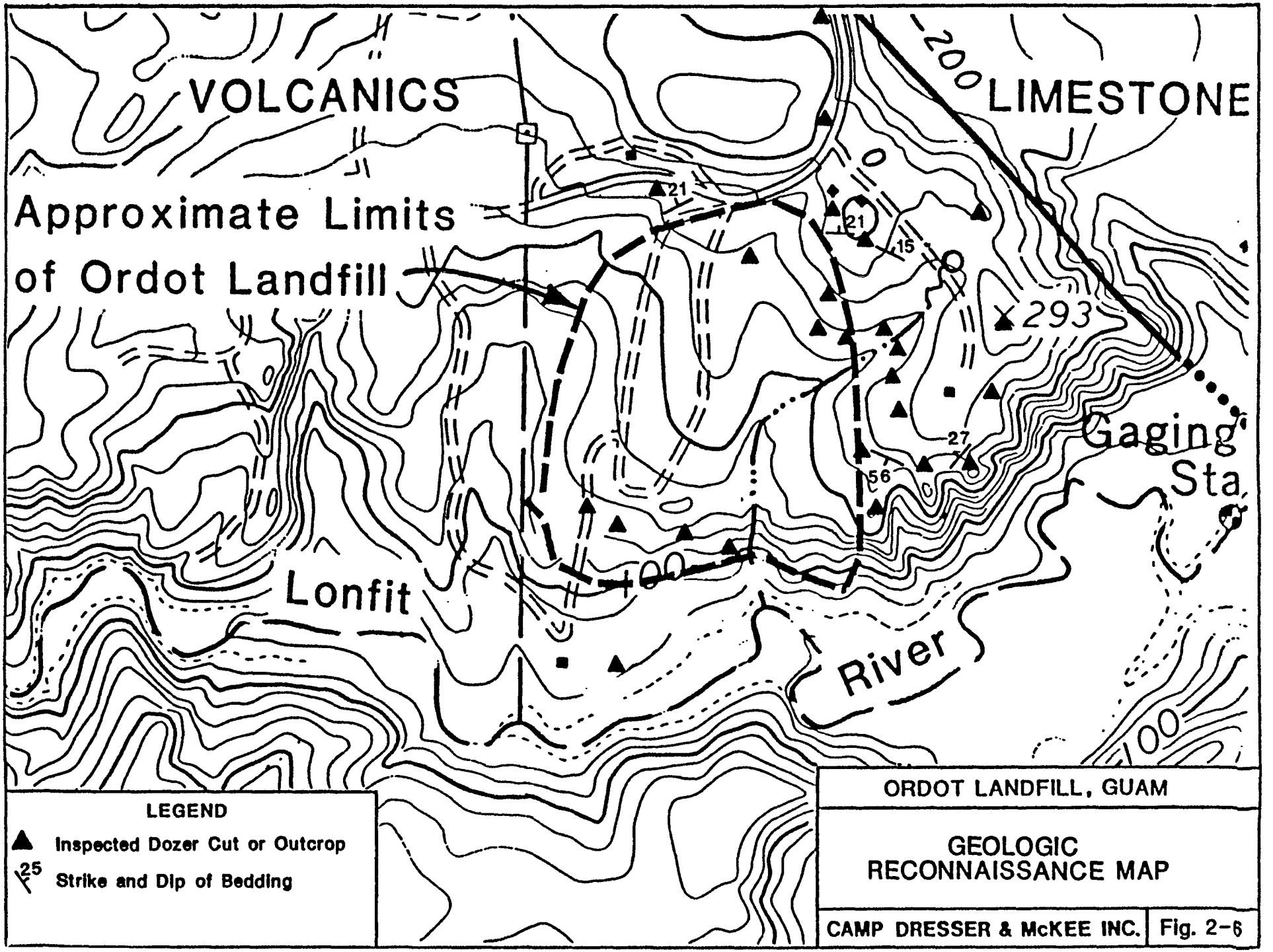
Field duplicates were also collected during the sampling program. As shown in Table 2-5, three duplicates were collected, with one from the municipal wells (GW-01), one from the Lonfit River (SW-01), and one from a WERI monitoring well (GW-06). In addition, travel blanks were included in each shipment of volatile organics. This QA/QC procedure identifies any potential cross contamination during shipment.

The samples were shipped from Guam via DHL International Service. The samples arrived at the laboratories within 72 hours of shipment. In all cases, the samples were shipped within two days of sample collection. Shipping on a daily basis was not possible due to the schedule of flights leaving the island. However, this problem was anticipated and the Special Analytical Service (SAS) request required the laboratory to immediately begin the analysis upon sample receipt. Therefore, none of the sample holding times were exceeded. The use of proper COC protocol and documentation of the field activities were discussed in the previous section.

2.2 SITE GEOLOGY

2.2.1 GEOLOGIC RECONNAISSANCE

A geologic reconnaissance of the Ordot landfill site area was conducted to determine: (1) the source of the spring on the north side of the landfill; (2) the location of the fault suggested in the literature which separates the southern volcanic province from the northern limestones; (3) determine the type of rocks which underlie and surround the site; and (4) to determine if groundwater flows from the site into the Northern Lens Limestone aquifer north of the site. The reconnaissance was performed by making small dozer trenches around the perimeter of the site and by examining road cuts and outcrops near the site. Fresh, unweathered samples were collected from several of these trenches for closer examination upon return from Guam by the field team. Figure 2-6 shows the location of the dozer trenches made during the reconnaissance-level investigation.


VOLCANICS
LIMESTONE
Approximate Limits
of Ordot Landfill
Lonfit
River
Gaging
Sta
-200
0
100
293
21
21
15
27
56
LEGEND
Inspected Dozer Cut or Outcrop
25
Strike and Dip of Bedding
ORDOT LANDFILL, GUAM
GEOLOGIC
RECONNAISSANCE MAP
CAMP DRESSER & McKEE INC.
Fig. 2-6

2.2.2 GEOLOGIC MATERIALS BENEATH THE SITE

Ordot Landfill is located near the northern boundary of Guam's volcanic province. The geologic materials which underlie the site consist of thinly bedded, tuffaceous shales and sandstones, with grain sizes ranging from clay to medium-grained sand (Tracey, et. al., 1963). Bedding ranges from a few millimeters to several meters in thickness. Typically, these deposits range in color from gray to light orange in fresh exposures and gray-green to dark red in weathered exposures. Gray-green beds are usually indicative of the coarser-grained tuffaceous sandstones, with the darker colored beds associated with the higher silica content of the matrix material.

Most of the rocks observed at the site exhibited varying degrees of weathering. In most unweathered exposures, the tuffs are fairly hard, but show chemical altering around individual angular grains. With weathering, the fine-grained matrix material breaks down to clay and the grains continue to weather, eventually to clay with little evidence of the original clastic texture. Weathering is prominent in most of the rocks exposed in the upper two to three feet of the surface. Rocks with little sign of weathering are exposed in the area used by the landfill operators as a source for cover material and in road cuts in and near the site. These unweathered rocks originally existed over ten feet below the ground surface. The weathered rocks, because of their high clay content, appear to have extremely low permeabilities. Unweathered rocks, because of their fine-grained matrix and partially altered clastic texture, also appear to have low permeabilities.

2.2.3 STRUCTURAL GEOLOGY

The rocks beneath the site are moderately folded and fractured. Bedding is folded into an anticline with an east-west axis. The north limb of the anticline dips 15 to 50 degrees. The south limb dips between 40 and 60 degrees. Folding is common within beds and appears to be due to depositional features. Fracturing was commonly observed in the rocks. However, most of the fractures are closed and, as such, may inhibit groundwater movement.

Major faulting was not observed in the beds exposed in or adjacent to the site area. Tracey, et. al. (1964) indicated a major northwest-southeast trending fault which passes just north of the Ordot site. This fault is thought to divide the northern limestones and the southern volcanics. Reconnaissance of the area did not substantiate the existence or absence of this fault. The steep terrain north of the site could be explained as either a major block fault or as a terrace (erosional) feature. A spring was thought to issue from the fault zone and subsequently flow through the site. However, on closer examination of the area, topography of the area appears to concentrate surface runoff and channel it into the site.

2.2.4 GROUNDWATER MOVEMENT BENEATH THE SITE

The site appears to be geologically isolated from the limestones of the Northern Lens Aquifer. The high clay content of the tuffaceous shales and sandstones appears to restrict infiltration of rainfall or surface inflow. As such, most of the water that enters the area, either as rainfall or as surface inflow, will flow south along the original ground topographic surface into the Lonfit River. However, rainfall at the site may result in a significant amount of infiltration into the landfill debris due to the inadequate cover utilized at the site.

The background WERI monitoring well in the northern part of the site contained only a small amount of water, indicating extremely low permeabilities for the rocks underlying the site. The apparently small amount of groundwater which flows through the site area probably follows the solid waste bedrock contact, which dips in a southerly direction beneath most of the site toward the Lonfit River. Groundwater beneath the southern portion of the site appears to be related to the alluvium associated with the Lonfit River. The groundwater gradient in the alluvium probably follows the topography and, as such, flows parallel to the Lonfit River and eventually enters Pago Bay on the eastern shore of the island.

2.3 RISK ASSESSMENT ACTIVITIES

An additional objective of the initial site characterization was to collect data in support of the Risk Assessment (RA). To achieve these objectives, several interviews with local officials were conducted to: (1) discuss potential contaminants suspected to be on site; (2) identify potential pathways off site; (3) characterize potential receptors in the area; and (4) assess the potential risk to public health. In addition, the area surrounding the landfill was toured to confirm the potential routes of exposure. This activity was performed by an individual from ICF/Clements, a member firm of the REM II Team. A memorandum summarizing the results of the observations and interviews is provided in Appendix A.

The information obtained from this activity will be included in the RA, which will be finalized under a REM IV work assignment.

3.0 RESULTS OF ANALYSES

The field activities were discussed in the preceding section. This section presents the results of the laboratory analysis as well as an interpretation of both the field and laboratory data. This section is divided into (1) surface water, groundwater and leachate sampling results; (2) air sampling results, and (3) results of geologic reconnaissance. In regard to the sampling, it should be noted that this effort was conducted during the dry season. Although sampling during the dry season would represent worst-case with respect to contaminant loading, it is recommended that additional sampling be conducted to accurately characterize the expected seasonal variations associated with the site.

3.1 SURFACE WATER, GROUNDWATER, AND LEACHATE SAMPLING RESULTS

As previously mentioned, all of the surface water, groundwater and leachate samples collected during the initial sampling were anlayzed for RAS HSL volatile, semi-voltile, pesticide/PCB, and inorganic constituents. Table 3-1 provides a list of all the constitents included in the analysis. Table 3-1 also provides the Contract Required Detection Limits (CRDL) which are used under RAS. These are the limits reported by the laboratories unless lower Instrument Detection Limits (IDL) could be achieved or interference resulted in a higher IDL. The RAS program was modified to include a shorter analytical holding time due to the longer time required to ship the samples from Guam.

The analytical data for the surface water/leachate and groundwater samples are presented in Tables 3-2 and 3-3, respectively. The sample locations are identified by the LOCID heading on each of the tables. The specific locations of each surface water and leachate sample are shown on Figure 2-1, whereas, the on- and off-site groundwater sample loctions are shown on Figures 2-1 and 2-2, respectively. Duplicate sample pairs are as follows: GW-01 and GW-02; SW-02 and SW-13; and GW-06 and GW-07.

TABLE 3-1

HAZARDOUS SUBSTANCE LIST (HSL) COMPOUNDS ANALYZED
AND THEIR QUANTITATION LIMITS

VOLATILES (ug/kg)

Chloromethane	10
Bromomethane	10
Vinyl Chloride	10
Chloroethane	10
Methylene Chloride	5
Acetone	10
Carbon Disulfide	5
1,1-Dichloroethene	5
1,1-Dichloroethane	5
trans-1,2-Dichloroethene	5
Chloroform	5
1,2-Dichloroethane	5
2-Butanone	10
1,1,1-Trichloroethane	5
Carbon Tetrachloride	5
Vinyl Acetate	10
Bromodichloromethane	5
1,1,2,2-Tetrachloroethane	5
1,2-Dichloropropane	5
trans-1,3-Dichloropropene	5
Trichloroethene	5
Dibromochloromethane	5
1,1,2-Trichloroethane	5
Benzene	5
cis-1,3-Dichloropropene	5
2-Chloroethyl Vinyl Ether	10
Bromoform	5
2-Hexanone	10
4-Methyl-2-pentanone	10
Tetrachloroethene	5
Toluene	5
Chlorobenzene	5
Ethyl Benzene	5
Styrene	5
Total Xylenes	5

TABLE 3-1 (Cont.)

HAZARDOUS SUBSTANCE LIST (HSL) COMPOUNDS ANALYZED
AND THEIR QUANTITATION LIMITS

Semi-Volatiles (ug/kg)

N-Nitrosodimenthylamine	330
Phenol	330
Aniline	330
bis(2-Chloroethyl)ether	330
2-Chlorophenol	330
1,3-Dichlorobenzene	330
1,4-Dichlorobenzene	330
Benzyl Alcohol	330
1,2-Dichlorobenzene	330
2-Methylphenol	330
bis(2-Chloroisopropyl)ether	330
4-Methylphenol	330
N-Nitroso-Dipropylamine	330
Hexachloroethane	330
Nitrobenzene	330
Isophorone	330
2-Nitrophenol	330
2,4-Dimethylphenol	330
Benzoic Acid	1600
bis(2-Chloroethoxy)methane	330
2,4-Dichlorophenol	330
1,2,4-Trichlorobenzene	330
Naphthalene	330
4-Chloroaniline	330
Hexachlorobutadiene	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	330
2-Methylnaphthalene	330
Hexachlorocyclopentadiene	330
2,4,6-Trichlorophenol	330
2,4,5-Trichlorophenol	1600
2-Chloronaphthalene	330
2-Nitroaniline	1600
Dimethyl Phthalate	330
Acenaphthylene	330
Acenaphthene	1600
2,4-Dinitrophenol	330
4-Nitrophenol	1600
Dibenzofuran	1600
2,4-Dinitrotoluene	330
2,6-Dinitrotoluene	330
Diethylphthalate	330
4-Chlorophenyl Phenyl ether	330
Fluorene	330
4-Nitroaniline	1600
4,6-Dinitro-2-methylphenol	1600
N-nitrosodiphenylamine	330
4-Bromophenyl Phenyl ether	330
Hexachlorobenzene	330
Pentachlorophenol	1600
Phenanthrene	330
Anthracene	330
Di-n-butylphthalate	330
Fluoranthene	330
Benzidine	1600
Pyrene	330
Butyl Benzyl Phthalate	330
3,3'-Dichlorobenzidine	660
Benzo(a)anthracene	330
bis(2-ethylhexyl)phthalate	330
Chrysene	330
Di-n-octyl Phthalate	330
Benzo(b)fluoranthene	330
Benzo(k) fluoranthene	330
Benzo(a)pyrene	330
Indeno(1,2,3-cd)pyrene	330
Dibenz(a,h)anthracene	330
Benzo(g,h,i)perylene	330
3-Nitroaniline	1600

TABLE 3-1 (Cont.)

HAZARDOUS SUBSTANCE LIST (HSL) COMPOUNDS ANALYZED
AND THEIR QUANTITATION LIMITS

PESTICIDES (ug/kg)

alpha-BHC	8.0
beta-BHC	8.0
delta-BHC	8.0
gamma-BHC (Lindane)	8.0
Heptachlor	8.0
Aldrin	8.0
Heptachlor Epoxide	8.0
Endosulfan I	8.0
Dieldrin	16.0
4,4'-DDE	16.0
Endrin	16.0
Endosulfan II	16.0
4,4'-DDD	16.0
Endrin Aldehyde	16.0
Endosulfan Sulfate	16.0
4,4'-DDT	16.0
Endrin Ketone	16.0
Methoxychlor	80.0
Chlordane	80.0
Toxaphene	160.0

TABLE 3-1 continued

METALS

Element	Quantification Limits Soil (mg/Kg)
Aluminum	100
Antimony	30
Arsenic	5
Barium	100
Beryllium	2.5
Cadmium	2.5
Calcium	2,500
Chromium	5
Cobalt	25
Copper	12
Iron	50
Lead	2.5
Magnesium	2,500
Manganese	7
Mercury	0.1
Nickel	20
Potassium	2,500
Selenium	2.5
Silver	5
Sodium	2,500
Thallium	5
Tin	20
Vanadium	25
Zinc	10

Table 3-2

ORNOT LANDFILL

SURFACE WATER/LEACHATE SAMPLE RESULTS

			SAMPLING LOCATION											
	SAMPLE LOCATION -->		SW-01		SW-02		SW-05		SW-07		SW-10		SW-13	
	Date sample taken -->		03/12/87		03/12/87		03/12/87		03/13/87		03/14/87		03/12/87	
	QA\QC Information -->				Dup. of SW-13								Dup. of SW-02	
ITES														
CONTAMINANT NAME	CAS #	UNIT	READING	DETECT	READING	DETECT	READING	DETECT	READING	DETECT	READING	DETECT	READING	DETECT
SE NEUTRAL/ACID EXTRACTABLE														
BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	ug/L	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	3.00 JB	10.00	2.00 JB	10.00
PHENOL	108-95-2	ug/L	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	3.00 J	10.00	10.00 U	10.00
TALS														
ALUMINUM	7429-90-5	ug/L	80.00	31.00	75.00	31.00	466.00	31.00	3583.00	31.00	150.00	31.00	70.00	31.00
ANTIMONY	7440-36-0	ug/L	20.00 U	20.00	20.00 U	20.00	20.00 U	20.00	20.00 U	20.00	20.00 U	20.00	20.00 U	20.00
ARSENIC	7440-38-2	ug/L	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00
BARIUM	7440-39-3	ug/L	5.00	0.90	4.00	0.90	54.00	0.90	307.00	0.90	113.00	0.90	4.00	0.90
BERYLLIUM	7440-41-7	ug/L	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20
CADMIUM	7440-43-9	ug/L	4.30 U	4.30	4.30 U	4.30	4.30 U	4.30	4.30 U	4.30	4.30 U	4.30	4.30 U	4.30
CALCIUM	7440-70-2	ug/L	42150.00	24.00	42720.00	24.00	66200.00	24.00	85070.00	24.00	103700.00	24.00	42580.00	24.00
CHROMIUM	7440-47-3	ug/L	3.70 U	3.70	3.70 U	3.70	3.70 U	3.70	11.00	3.70	3.70 U	3.70	3.70 U	3.70
COBALT	7440-48-4	ug/L	6.80 U	6.80	6.80 U	6.80	6.80 U	6.80	13.00	6.80	6.80 U	6.80	6.80 U	6.80
COPPER	7440-50-8	ug/L	5.90 U	5.90	5.90 U	5.90	10.00	5.90	31.00	5.90	5.90 U	5.90	5.90 U	5.90
CYANIDE	74-90-8	ug/L	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00	6.20	20.00 U	20.00
IRON	7439-89-6	ug/L	106.00	9.20	223.00 J	9.20	639.00	9.20	39260.00	9.20	243.00	9.20	110.00 J	9.20
LEAD	7439-92-1	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	18.00	2.00	5.30	2.00	5.00 U	5.00
MAGNESIUM	7439-95-4	ug/L	8745.00	40.00	9210.00	40.00	54290.00	40.00	60290.00	40.00	23580.00	40.00	9166.00	40.00
MANGANESE	7439-96-5	ug/L	20.00	0.60	5.00	0.60	142.00	0.60	3161.00	0.60	224.00	0.60	4.00	0.60
MERCURY	7439-97-6	ug/L	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20	0.20 U	0.15
NICKEL	7440-02-0	ug/L	23.00 U	23.00	23.00 U	23.00	23.00 U	23.00	23.00 U	23.00	23.00 U	23.00	23.00 U	23.00
POTASSIUM	7440-09-7	ug/L	948.00 U	948.0	948.00 U	948.0	14740.00	948.0	22220.00	948.0	15850.00	948.0	948.00 U	948.0
SELENIUM	7782-49-2	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	25.00 U	25.00	5.00 U	5.00	5.00 U	5.00
SILVER	7440-22-4	ug/L	5.10 U	5.10	5.10 U	5.10	5.10 U	5.10	5.10 U	5.10	5.10 U	5.10	5.10 U	5.10
SODIUM	7440-23-5	ug/L	17090.00	20.00	19180.00	20.00	126600.00	20.00	119800.00	20.00	92070.00	20.00	19040.00	20.00
THALLIUM	7440-28-0	ug/L	10.00 U	10.00	10.00 U	2.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00
TIN	7440-31-5	ug/L	17.00 U	17.00	17.00 U	17.00	17.00 U	17.00	17.00 U	17.00	17.00 U	17.00	17.00 U	17.00
VANADIUM	7440-62-2	ug/L	5.40	3.10	3.60	3.10	3.10 U	3.10	12.00	3.10	3.10 U	3.10	3.90	3.10
ZINC	7440-66-6	ug/L	9.00	1.30	10.00	1.30	31.00	1.30	73.00	1.30	9.00	1.30	10.00	1.30
LATILE ORGANICS														
,1,2,2-TETRACHLOROETHANE	79-34-5	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
-BUTANONE	78-93-3	ug/L	6.00 JB	10.00	8.00 JB	10.00	12.00 B	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00
ACETONE	67-64-1	ug/L	2.00 JB	10.00	2.00 JB	10.00	5.00 JB	10.00	8.00 JB	10.00	10.00 U	10.00	10.00 U	10.00
CARBON DISULFIDE	75-15-0	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	1.00 J	5.00	5.00 U	5.00	5.00 U	5.00
CHLOROBENZENE	108-90-7	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	3.00 J	5.00	5.00 U	5.00	5.00 U	5.00
ETHYLBENZENE	100-41-4	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
METHYLENE CHLORIDE (DICHLOROMETHANE)	75-09-2	ug/L	5.00 U	5.00	2.00 JB	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
STYRENE	100-42-5	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
TOLUENE	108-88-3	ug/L	1.00 JB	5.00	1.00 JB	5.00	1.00 JB	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
XYLENES (TOTAL)	1330-20-7	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00

Table 3-2 (cont.)

FOOTNOTES

U - The material was analyzed for, but was not detected. The associated numerical value is the estimated detection limit for that sample.

J - The associated numerical value is an estimated quantity because the amount detected is below the required limits or because quality control criteria were not met.

B - Compound was also detected in the blank. Quantity reported is less than 5 times the amount found in the blank (less than 10 times for methylene chloride, acetone, toluene, and phthalates).

R - Quality Control indicates that data is not usable (i.e. compound may may not be present). Resampling and reanalysis is necessary for verification.

UJB - The estimated sample detection limit was increased and the compound was also detected in the blank. The amount found in the sample was reported. The compound was detected at less than 5 times the amount in blank (less than 10 times for methylene chloride, acetone, toluene and phthalates).

EJ - The value reported was estimated due to interference problems (ICP serial dilution or no spike recovery by graphite furnace).

JB - The value is an estimated amount detected below required limits because quality control criteria were not met; the compound was also detected in the blank.

N - Tentative identification of a compound that is not on the Hazardous Substance List. Resampling and reanalysis is necessary for verification.

UJ - No contamination or analytical deficiencies; Quantitative limit was adjusted

JL - The value reported was estimate due to exceedint ICP linear range.

JS - The value reported was estimate due to spike recoveries outside limits.

JC - The value reported was estimate due to instrument calibration problems.

M - Benzo(b) and Benzo(k) Fluoranthene not separated due to matrix.

JN - Tentative identification of a compound that is not on the Hazardous Substance List. Resampling and reanalysis is necessary for verification.

Table 3-3

ORDOT LANDFILL
GROUND WATER SAMPLE RESULTS

			SAMPLING LOCATION											
	SAMPLE LOCATION -->		GW-01		GW-02		GW-03		GW-04		GW-05		GW-06	
	Date sample taken -->		03/12/87		03/12/87		03/12/87		03/13/87		03/13/87		03/13/87	
	QA\QC Information -->		Dup. of GW-02		Dup. of GW-01								Dup. of GW-07	
BIBS CONTAMINANT NAME	CAS #	UNIT	READING	DETECT	READING	DETECT	READING	DETECT	READING	DETECT	READING	DETECT	READING	DETECT
SE NEUTRAL/ACID EXTRACTABLE														
BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	ug/L	2.00 JB	10.00	10.00 U	10.00	2.00 JB	10.00	88.00	10.00	2.00 JB	10.00	5.00 JB	10.00
PHENOL	108-95-2	ug/L	10.00 U	10.00	10.00 U	10.00	5.00 J	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00
TALS														
ALUMINUM	7429-90-5	ug/L	41.00	31.00	50.00	31.00	45.00	31.00	77.00	31.00	837.00	31.00	831.00	31.00
ANTIMONY	7440-36-0	ug/L	20.00 U	20.00	20.00 U	20.00	20.00 U	20.00	20.00 U	20.00	20.00 U	20.00	20.00 U	20.00
ARSENIC	7440-38-2	ug/L	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00
BARIUM	7440-39-3	ug/L	6.00	0.90	6.00	0.90	5.00	0.90	9.00	0.90	190.00	0.90	15.00	0.90
BERYLLIUM	7440-41-7	ug/L	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20
CADMIUM	7440-43-9	ug/L	4.30 U	4.30	4.30 U	4.30	4.30 U	4.30	4.30 U	4.30	4.30 U	4.30	4.30 U	4.30
CALCIUM	7440-70-2	ug/L	117000.00	24.00	116700.00	24.00	113000.00	24.00	53930.00	24.00	41610.00	24.00	85960.00	24.00
CHROMIUM	7440-47-3	ug/L	3.70 U	3.70	3.70 U	3.70	3.70 U	3.70	3.70 U	3.70	3.70 U	3.70	3.70 U	3.70
COBALT	7440-48-4	ug/L	6.00 U	6.00	6.00 U	6.00	6.00 U	6.00	6.00 U	6.00	15.00	6.00	6.00 U	6.00
COPPER	7440-50-8	ug/L	6.00	5.90	5.90 U	5.90	10.00	5.90	5.90 U	5.90	6.00	5.90	34.00 J	5.90
CYANIDE	74-90-8	ug/L	10.00 U	10.00	10.00 U	10.00	16.00	6.20	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00
IRON	7439-89-6	ug/L	75.00	9.20	38.00	9.20	65.00	9.20	124.00	9.20	631.00	9.20	895.00	9.20
LEAD	7439-92-1	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
MAGNESIUM	7439-95-4	ug/L	4151.00	40.00	4102.00	40.00	3215.00	40.00	7491.00	40.00	31210.00	40.00	59130.00	40.00
MANGANESE	7439-96-5	ug/L	1.00	0.60	0.60 U	0.60	4.00	0.60	8.00	0.60	87.00	0.60	92.00	0.60
MERCURY	7439-97-6	ug/L	0.20 U	0.20	0.20 U	0.20	1.06 J	0.15	0.20 U	0.20	0.20 U	0.20	0.20 U	0.20
NICKEL	7440-02-0	ug/L	23.00 U	23.00	23.00 U	23.00	23.00 U	23.00	23.00 U	23.00	32.00	23.00	23.00 U	23.00
POTASSIUM	7440-09-7	ug/L	948.00 U	948.0	948.00 U	948.0	948.00 U	948.0	948.00 U	948.0	948.00 U	948.0	948.00 U	948.0
SELENIUM	7782-49-2	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
SILVER	7440-22-4	ug/L	5.10 U	5.10	5.10 U	5.10	5.10 U	5.10	5.10 U	5.10	5.10 U	5.10	5.10 U	5.10
SODIUM	7440-23-5	ug/L	11110.00	20.00	11040.00 U	20.00	8674.00	20.00	12880.00	20.00	38650.00	20.00	62130.00	20.00
THALLIUM	7440-28-0	ug/L	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00
TIN	7440-31-5	ug/L	17.00 U	17.00	17.00 U	17.00	17.00 U	17.00	17.00 U	17.00	17.00 U	17.00	17.00 U	17.00
VANADIUM	7440-62-2	ug/L	3.10 U	3.10	3.10 U	3.10	3.10 U	3.10	3.10 U	3.10	3.60	3.10	6.90	3.10
ZINC	7440-66-6	ug/L	44.00	1.30	42.00	1.30	45.00	1.30	20.00	1.30	137.00	1.30	162.00	1.30
LATILE ORGANICS														
1,1,2,2-TETRACHLOROETHANE	79-34-5	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
2-BUTANONE	78-93-3	ug/L	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	10.00 U	10.00	9.00 JB	10.00
ACETONE	67-64-1	ug/L	10.00 U	10.00	4.00 JB	10.00	3.00 JB	10.00	3.00 JB	10.00	3.00 JB	10.00	3.00 JB	10.00
CARBON DISULFIDE	75-15-0	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
CHLOROBENZENE	108-90-7	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
ETHYLBENZENE	100-41-4	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
METHYLENE CHLORIDE (DICHLOROMETHANE)	75-09-2	ug/L	5.00 U	5.00	5.00 U	5.00	2.00 JB	5.00	5.00 U	5.00	3.00 JB	5.00	5.00 U	5.00
STYRENE	100-42-5	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00
TOLUENE	108-88-3	ug/L	5.00 U	5.00	5.00 U	5.00	1.00 JB	5.00	1.00 JB	5.00	5.00 U	5.00	1.00 J	5.00
XYLENES (TOTAL)	1330-20-7	ug/L	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00	5.00 U	5.00

Table 3-3
ORDOT LANDFILL
GROUND WATER SAMPLE RESULTS

	SAMPLING LOCATION			
	SAMPLE LOCATION -->	GW-07		
	Date sample taken -->	03/13/87		
	QA\QC Information -->	Dup. of GW-06		
BIES CONTAMINANT NAME	CAS #	UNIT	READING	DETECT
SE NEUTRAL/ACID EXTRACTABLE				
BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	ug/L	3.00 JB	10.00
PHENOL	108-95-2	ug/L	10.00 U	10.00
TALS				
ALUMINUM	7429-90-5	ug/L	876.00	31.00
ANTIMONY	7440-36-0	ug/L	20.00 U	20.00
ARSENIC	7440-38-2	ug/L	10.00 U	10.00
BARIUM	7440-39-3	ug/L	11.00	0.90
BERYLLIUM	7440-41-7	ug/L	0.20 U	0.20
CADMIUM	7440-43-9	ug/L	4.30 U	4.30
CALCIUM	7440-70-2	ug/L	88870.00	24.00
CHROMIUM	7440-47-3	ug/L	3.70 U	3.70
COBALT	7440-48-4	ug/L	6.80 U	6.80
COPPER	7440-50-8	ug/L	10.00	5.90
CYANIDE	74-90-8	ug/L	10.00 U	10.00
IRON	7439-89-6	ug/L	1014.00	9.20
LEAD	7439-92-1	ug/L	5.90	2.00
AGNESIUM	7439-95-4	ug/L	61980.00	40.00
ANGANESE	7439-96-5	ug/L	91.00	0.60
ERCURY	7439-97-6	ug/L	0.20 U	0.20
ICKEL	7440-02-0	ug/L	23.00 U	23.00
OTASSIUM	7440-09-7	ug/L	948.00 U	948.0
ELENIUM	7782-49-2	ug/L	5.00 U	5.00
ILVER	7440-22-4	ug/L	5.10 U	5.10
ODIUM	7440-23-5	ug/L	65710.00	20.00
HALLIUM	7440-28-0	ug/L	10.00 U	10.00
IN	7440-31-5	ug/L	17.00 U	17.00
ANADIUM	7440-62-2	ug/L	6.30	3.10
INC	7440-66-6	ug/L	133.00	1.30
ATILE ORGANICS				
,1,2,2-TETRACHLOROETHANE	79-34-5	ug/L	5.00 U	5.00
BUTANONE	78-93-3	ug/L	10.00 U	10.00
ETONE	67-64-1	ug/L	10.00 U	10.00
ARBON DISULFIDE	75-15-0	ug/L	5.00 U	5.00
LOROBENZENE	108-90-7	ug/L	5.00 U	5.00
THYLBENZENE	100-41-4	ug/L	5.00 U	5.00
THYLENE CHLORIDE (DICHLOROMETHANE)	75-09-2	ug/L	5.00 U	5.00
TRENE	100-42-5	ug/L	5.00 U	5.00
LUENE	108-88-3	ug/L	5.00 U	5.00
LENES (TOTAL)	1330-20-7	ug/L	5.00 U	5.00

Table 3-3

FOOTNOTES

U - The material was analyzed for, but was not detected. The associated numerical value is the estimated detection limit for that sample.

J - The associated numerical value is an estimated quantity because the amount detected is below the required limits or because quality control criteria were not met.

B - Compound was also detected in the blank. Quantity reported is less than 5 times the amount found in the blank (less than 10 times for methylene chloride, acetone, toluene, and phthalates).

R - Quality Control indicates that data is not usable (i.e. compound may may not be present). Resampling and reanalysis is necessary for verification.

UJB - The estimated sample detection limit was increased and the compound was also detected in the blank. The amount found in the sample was reported. The compound was detected at less than 5 times the amount in blank (less than 10 times for methylene chloride, acetone, toluene and phthalates).

EJ - The value reported was estimated due to interference problems (ICP serial dilution or no spike recovery by graphite furnace).

JB - The value is an estimated amount detected below required limits because quality control criteria were not met; the compound was also detected in the blank.

N - Tentative identification of a compound that is not on the Hazardous Substance List. Resampling and reanalysis is necessary for verification.

UJ - No contamination or analytical deficiencies; Quantitative limit was adjusted

JL - The value reported was estimate due to exceedint ICP linear range.

JS - The value reported was estimate due to spike recoveries outside limits.

JC - The value reported was estimate due to instrument calibration problems.

N - Benzo(b) and Benzo(k) Fluoranthene not separated due to matrix.

JN - Tentative identification of a compound that is not on the Hazardous Substance List. Resampling and reanalysis is necessary for verification.

The analytical data presented in Tables 3-2 and 3-3 have undergone data validation. As a result, certain data points have been assigned validation qualifiers, indicated by letters. Use of the data in making interpretation is constrained by consideration of these qualifiers. For instance, analytical values qualified by the letter J were identified as having minor laboratory QA/QC problems or the results reported were below the CRDL. As such, these values are identified as estimates and are considered usable for limited purposes only. The values modified by a letter B indicate that the constituent was also found in the method blank, indicating laboratory contamination. Therefore, these values may be unreliable and should also only be used for limited purposes.

The analytical data for the samples SW-05, SW-07, and SW-10 are presented in Table 3-2. Inspection of the data indicate that water quality of the leachate is generally poor, particularly considering the high concentrations of the inorganic constituents. However, none of the inorganic constituents exceed the USEPA maximum contaminant limits (MCLs), although iron and manganese generally exceed the secondary maximum contaminant limits (SMCLs) for all of the leachate samples. With regard to organic constituents, only trace levels of carbon disulfide and chlorobenzene were detected in sample SW-7, and phenol was detected in SW-10. Each of these constituents were detected in amounts below the CRDL and are qualified as such. All of the other organic constituents analyzed under the CLP RAS program were either undetected or detected in the method blank, indicating laboratory contamination.

Samples were also collected from the Lonfit River to determine the potential impact of the landfill on the water quality of the river. Sample SW-01 was collected from the Lonfit River upgradient of the landfill, whereas sample SW-02 was collected downgradient. Sample SW-13 represents a duplicate of SW-02. The analytical results for these samples are presented in Table 3-2.

Examination of the data for the Lonfit River indicate that the water quality is generally better than the leachate quality. This is

particularly true for the inorganic constituents, which in many cases are an order of magnitude less than the inorganic constituent concentrations detected in the leachate samples. In addition, none of the constituent concentrations detected in the Lonfit River exceeded the MCLs or SMCLs, and none of the organic constituents were detected in any of the samples. Finally, comparison of the data for the downgradient sample (SW-02) with the data from the upgradient sample (SW-01) indicates that the leachate discharging to the Lonfit River has little impact on the river water quality. For example, a comparison between many of the major ions in the samples indicate that there was little to no change in the water quality. However, an impact on the river may occur if there is an instantaneous release of contamination from the landfill.

The analytical results for the groundwater samples are presented in Table 3-3. Samples GW-01 and GW-03 were collected from municipal wells located in the vicinity of the landfill (Figure 2-2). Sample GW-02 represents a duplicate of GW-01. Samples GW-04, GW-05, and GW-06 were collected from monitoring wells located within the site boundary (Figure 2-1). Sample GW-07 represents a duplicate of GW-06. Sample GW-04 was collected from the upgradient monitoring well.

The samples collected from the on-site downgradient monitoring wells (GW-05 and GW-06) show a general degradation in water quality when compared to the sample collected from the upgradient well (GW-04). For the most part, every major inorganic constituent increased in concentration downgradient. In some cases, there was an order of magnitude increase in concentration (e.g., sodium, zinc). Furthermore, iron and manganese in both of the downgradient groundwater samples exceeded the SMCLs. Organics constituents were not detected in any of the on-site monitoring wells, with the exception of a phthalate in the upgradient well. The presence of phthalate indicates the possible presence of plasticides.

The water quality data for the samples collected from the off-site municipal wells are similar to the data for the upgradient monitoring well, when considering the concentration of some of the major metals such as sodium and magnesium. In that the water quality is similar to the

upgradient well and there does not appear to be a degradation in water quality similar to that observed in the downgradient monitoring wells, it appears that the off-site municipal wells are unaffected by the landfill. Furthermore, the geologic investigation previously discussed in Section 2.2 indicates that the limestone unit in which the municipal wells are completed is geologically and hydrologically isolated from the landfill. Therefore, there does not appear to be a pathway present which would result in the off-site contamination of these wells.

Phenol was detected at a concentration of 5.0 $\mu g/l$ in sample GW-03. However, this value was qualified since it was detected below the CRDL. The source of the phenol is not known. No other organic constituents were detected in the off-site municipal wells sampled.

3.2 AIR SAMPLING RESULTS

As previously mentioned in Section 2.1.4, a reconnaissance air sampling effort was conducted at the facility using portable field instruments. The data collected in the field were presented in Section 2.1.4. The transect locations, as well as the locations of the areas where elevated readings were observed, are provided on Figures 2-4 through 2-5.

The results of the reconnaissance-level air quality survey indicate that air emissions from the landfill do not present a major problem. For example, the average response of most of the instruments along the transects were either zero or not above background levels. The exception is the responses observed for the OVA. In general, the OVA consistently maintained readings on the order of 2 to 7 ppm above background over the entire transect (Table 2-4). In addition, at several locations along the transects, elevated readings on the OVA were observed, particularly along the southern portions of transects 2 and 3 (Figures 2-3 through 2-5). The OVA readings obtained at these locations ranged from 2 to 100 ppm, although the upper levels generally represented short spikes which were not sustained for extended periods of time.

The type of instrument responses observed at the landfill suggest that small amounts of methane are being produced and emitted from the landfill. For example, the HNu, which does not respond to methane gas, did not respond while conducting the transects. However, the OVA, which does detect methane gas, generally responded above background along the entire course of the transects.

As previously mentioned, elevated responses above background from the OVA were observed along the southern portions of transects. Elevated readings were consistently obtained at sites T3A or T3B for each day the surveys were performed. In addition, elevated readings were also obtained at site T2A on two of the three days the survey was performed. Elevated readings were not consistently observed over the three days at other points along the transects.

The reconnaissance-level air sampling data collected over the course of three days indicates that methane is being produced from the southern portion landfill. This portion of the landfill is the oldest and, consequently, the waste has had the most opportunity to degrade. However, other portions of the landfill are presently not generating much methane, according to the low OVA response levels observed along the transects. In addition, areas where methane was consistently being produced were not identified, other than points located along the southern portion of transects 2 and 3. Furthermore, the instrument responses at these points were not sustainable at the higher levels, indicating that the methane production was not sustainable. Given these aspects, it appears that the landfill does not represent an air quality problem. Therefore, additional characterization of the air quality during future studies is not recommended.

3.3 RESULTS OF GEOLOGIC RECONNAISSANCE

The activities conducted during the geologic reconnaissance were previously described in Section 2.2. The results of that reconnaissance indicate that the landfill is underlain by fine-grained volcanic deposits. These

deposits appear to be of very low permeability, based on observations of the surficial material. This low permeability of the material was confirmed by the fact that two of the on-site monitoring wells were bailed dry during the sampling effort.

There does not appear to be any of the carbonate deposits present in the immediate site vicinity, based on available outcrop information. One of the initial concerns about the Ordot landfill site was the potential for leachate contaminating the limestone aquifer in the vicinity. However, the site appears to be hydrologically isolated from the limestone aquifer, based on the observations associated with the geologic reconnaissance. Furthermore, any groundwater on site would probably flow along bedding planes or along the contact between the landfill material and the bedrock deposits, both of which dip to the south away from the island's major limestone aquifer toward the Lonfit River. Therefore, there does not appear to be a pathway for groundwater contamination to effect the limestone aquifer.

3.4 CONCLUSIONS

The on-site monitoring well sampling results indicate that there is a general degradation in water quality downgradient of the landfill. This is apparent when comparing the concentrations of some of the inorganic constituents between the upgradient and downgradient monitoring wells. In addition, the concentrations of both iron and manganese in the downgradient wells exceed the SMCLs. However, none of the MCLs are exceeded.

An initial concern about the site was the potential for contamination of the limestone aquifer, which is located in the vicinity of the landfill. However, the reconnaissance-level geologic investigation clearly indicates that the site is underlain by volcanic deposits of low permeability. Furthermore, the groundwater flow present at the site appears to be to the south away from the limestone aquifer. Therefore, it appears that the landfill is hydrologically isolated from the limestone aquifer. This aspect is corroborated by the fact that the on-site upgradient monitoring well has similar water quality as the municipal wells completed in the

limestone aquifer, indicating that the municipal wells have not been affected by the site. In that the reconnaissance-level investigation meet the objectives of the program, it does not appear that a detailed geologic investigation will be required.

The water quality of the leachate samples is generally poor, based on examination of the metals data. In general, the concentrations of the manganese and iron in the leachate samples exceeded the SMCLs. However, the leachate appears to have little impact on the Lonfit River water quality. For example, the water quality of the upgradient and downgradient locations on the Lonfit River are very similar, indicating that the leachate has very little impact on the river water quality.

The leachate which issues from the toe of the landfill appears to be derived almost entirely from rainfall and surface water which enters the site from the north. The landfill appears to have a relatively high storage capacity, which allows for the storage and subsequent release of water through the dry season, resulting in the perennial flow of the leachate streams. However, the number of the leachate streams issuing from the landfill are much higher during the wet season, based on observations and interviews conducted during the Initial Site Inspection conducted in October 1985. As previously mentioned, large seasonal variations in leachate production can be expected from the landfill. However, samples have not been collected during the wet season at the site. As such, the variation in leachate production and quality from the landfill has not been accurately characterized, particularly during the wet season.

The reconnaissance-level air survey indicates that there is a minor amount of methane being produced from the landfill. The methane produced appears to be dominantly derived from the older portions of the landfill. The older portions are located to the south quadrant of the landfill. The methane production does not appear to be substainable, due to the short durations of elevated readings. Although minor amounts of methane are being produced, it does not appear that significant quantities of other gases are being emitted. This was confirmed by observations of the field

team while on site. For example, significant noxious odors were not observed, nor were any dead animals present. As such, the landfill is apparently not a significant air quality problem at this time.

4.0 POTENTIAL SITE REMEDIATIONS AND RECOMMENDATIONS FOR FURTHER INVESTIGATIONS

4.1 POTENTIAL SITE REMEDIATIONS

Several measures could be undertaken to help remediate the leachate production from the landfill. One measure includes installing a perimeter drainage collection system to prevent water from running onto the landfill. An additional measure includes placing a low-permeability soil cover over the landfill. Presently, the cover on the landfill is very sparse to non-existent. In fact, many of the older portions of the landfill are not covered at all. The final cover should be designed with a permeability at least comparable to the permeability of the underlying native volcanic material. A final cover drainage control should be designed to prevent water from running onto the landfill, as well as to prevent the ponding of water on the cover. This drainage needs to consider preferential settlement of the landfill and cover surface. Finally, the cover and perimeter drainage collection system needs to consider the hydrology of the area, particularly size of the drainage area, as well as the rainfall and storm intensity data.

Depending on the effectivenss of the proposed cover and peripheral drainage collection system, an additional remediation to be considered for the site may be a cutoff wall or collection system for the major leachate streams issuing from the landfill. This measure would prevent the discharge of large volumes of leachate into the Lonfit River. Although the discharges presently do not appear to have an effect on the Lonfit River water quality based on the recent sampling effort, there may be seasonal variations in the quality and volume of leachate produced from the landfill. Presently, the seasonal variations are not well defined since only one sampling effort has been conducted during the dry season. As such, sampling programs should be conducted during the other seasons.

4.2 RECOMMENDATIONS FOR FURTHER INVESTIGATIONS

The data deficiencies previously identified consist of: (1) definition of the seasonal variations in leachate quality and quantity, (2) collection of hydrologic information of sufficient detail to design the appropriate remedial measures for the site, and (3) identification of a nearby source of cover material that can be used at the site.

In regard to the leachate emissions from the landfill, it is recommended that a quarterly sampling effort is conducted for a period of one year. This approach will result in a database which accurately characterizes the seasonal variations in the leachate quality and quantity. It is recommended that the volume of leachate being generated be accurately measured and samples be collected for RAS volatiles, semi-volatiles, pesticides/PCBs and metals.

The hydrologic information should include a determination of drainage area, rainfall and storm intensity data, and runoff information. To augment historical data, a weather station should be installed at the site to measure local variations in the regional climatic conditions. A potential source of existing information may include the USGS, Navy, airport, University of Guam and other federal or local agencies.

APPENDIX A

NOTES: GUAM/ORDOT SITE VISIT
MARCH 11-14, 1987
D. WAYNE BERMAN, ICF-CLEMENT

FIELD MEMO:

March 11, 1987:

Arrived 5 a.m. and had to locate accommodations because the original reservations were not honored.

Met Jim Kanto at the Guam Environmental Protection Agency (GEPA) and discussed data needs for the Ordot risk assessment. He recommended several GEPA staff and contacts at other organizations who might have relevant information.

Met with Mel Borja (GEPA) and briefly discussed conditions at the Ordot landfill including accessibility drainage, climate, geology, surrounding land use, and topology. Discussed the island economy and population habits as well as local flora and fauna. He provided several additional contacts.

Met with Tony Limtico, a local oil reclaimer. He contracts with clients to clean-up oil spills and handles PCBs for disposal. We discussed local industry hazardous waste handling and disposal practices. Also gained a general perspective on the history of the Ordot landfill. Since he also contracts with the military, we also discussed military handling and disposal of hazardous wastes. Meeting was quite helpful in providing a general overview.

March 12, 1987:

Visited the Ordot site and took a tour. Noted scavengers, local land use, local flora and fauna, and local drainage patterns. A spring emanates from the lower slope of the landfill. Contacted Naval Petty Officer Bennington to obtain a local weather summary.

Met with Bob Anderson (Fish and Wildlife Service). Discussed details of local fauna. Provided references to other studies that have been conducted and provided a contact at the Honolulu office, who conducted the studies: Andy Yuen. Identified several endangered species that may inhabit the watershed that drains the landfill. Discussed the fauna of the Agana swamp that also may receive drainage from the landfill.

Met with Gary Cami, Director of the Aquatic and Wildlife Division, and Rob Myers and discussed local aquatic species in Pago Bay and the rivers feeding Pago Bay. He provided additional contacts for more detail.

March 13, 1987:

Toured the areas surrounding the landfill to identify or confirm potential pathways and routes of exposure. Followed the Lonfit River to confirm adjacent land use and the presence of local swimming holes. Traced the Pago River to Pago Bay to confirm local access and use of these bodies of water. Took photographs to document observations.

Met with Paul Liebendorfer (GEPA) to discuss water use on the island including domestic and agricultural. Also discussed available analyses (water quality) and treatment (chlorination) throughout the municipal system. He suggested I talk further with the Public Utilities Agency, Guam (PUAG).

Met with John Davidson (PUAG). Discussed details of the municipal water supply system including: locations and analyses from production wells, treatment, and distribution. Also discussed allocation for different uses.

Picked up and copied additional referenced documents from GEPA.

March 14,1987:

Assisted in the sampling effort at the site. Collected samples from the spring emanating from the downslope edge of the landfill.

Left Guam at 4 p.m.

INFORMATION SUMMARY

A brief somewhat cryptic summary of relevant observations and verbal information (outlined in the original trip notes) is presented below. Additional and confirmatory information will be collected and referenced from the written documents identified by the individuals interviewed. The information will also be better assembled and presented in greater detail in association with the actual preliminary EA.

Mel Borja:

Landfill access:
- o There are scavengers at the landfill.

Drainage:
- o The Signa and Lonfit merge to form the Pago River which drains to Pago Bay. This system drains part of the landfill.
- o Rivers have limited aquatic life: gobis and small mouth bass, prawns and mollusks, and some fresh water eels.
- o There is only very limited fresh water fishing.
- o Kids swim at the first guaging station on the river.
- o Pago Bay has no shell fish. There is some net and line fishing in the bay, which is also used for swimming and boating.

Land use:
- o The Bell and Rameriz properties abut the landfill and they farm vegetables and bananas. Most of the remaining area is "residential".
- o The nearest residents and a school are a quarter mile away.
- o Pigs and deer have been introduced to Guam and there is limited hunting.
- o Blue tailed skinks and house gekkos are native.

Climate:
- o Winds are predominately easterly so the school is upwind.

Contacts:
- o Talk to the Bob Anderson at the DoA: Div. of Aquatic and Wildlife.
- o Paul Leibenderfer can provide information on water use. Note, there are reports provided.
- o Tony Limtico knows about waste handling and Ordot History.

Tony Limtico:

Local Industry (potential sources):
- o Guam used to have an oil refinery otherwise not a lot of chemical industry. Most development has occurred in the last 10 years and it is mostly for the tourist trade and to support the military.
- o There is one dry cleaner, Brewer Chemical (a distributer), a few paint companies, a couple of autobody repair shops, gas stations, a few aircraft maintenance shops, and not much else that would use significant volumes of hazardous materials or solvents.
- o The military currently takes care of its own wastes, which get shipped off island. This may not have been done prior to 1981. However, the navy and air force probably have their own landfills. The navy had a sludge farm.

- o Wastes dumped at the Ordot site could have come from any of these sources in the past. There may be hospital wastes and domestic wastes. It is not known if any military wastes are present. Most solvent wastes are currently burned.
- o A 1982 study found only pesticides: Endrin and Dieldrin. (Comment from Jim Goodrich).

History:
- o There have been subterranean fires at the landfill.
- o Unknown where the Japanese dumped their wastes during the war. Tony's Operation:
- o Tony has a water/oil separator and the waste oil goes to the power company for incineration. Non-oil compatible wastes he does not accept. The military wastes he handles he ships off island.

Site Visit Observations:
- o Toads and lizards are ubiquitious in the fill.
- o There are numerous scavengers working alongside the active fill.
- o There is greenish discoloration where leachate flows during the rainy season.
- o Jungle vegetation surrounds the fill.
- o The leachate pond at the bottom is currently dry. Note: the pond drains a different part of the landfill than the Lonfit River.
- o The leachate seep (spring) is currently trickling but has cut a several foot deep and several foot wide ditch. There are frogs and snails in the leachate drainage. (Jim Goodrich: during the wet season the flow is heavy. It also flowed over the top of the landfill.)
- o There is a leachate swamp at the NE end of the landfill where the seep occurs.
- o The Lonfit is flowing at approx. 1ft/s in a 10 foot by 0.5 foot stream.
- o The Pago above the Lonfit does not drain the site.

Bob Anderson:

Contacts:
- o Andy Yuen (other studies of flora and fauna)-Honolulu

US Fish and Wildlife Service
300 Ala Moana Blvd.
#6307
Box 50167
Honolulu, Hawaii 96850
808-546-7530

- o Leroy Heights (Water and Energy Resources) also had a permit to sample the streams in the area.
- o Bruce Rinehart (Batelle) is investigating Anderson dump at the air force base.

Pago Bay:
- o Lower reaches of Pago River, people fish. There is a lot of fishing in Pago Bay. Fish are caught largely for direct consumption although some are sold commercially-peddling.
- o There are no listed endangered fish on Guam. Terrestrial Animals:

- o Golden luvers are probably found in the dump. The Guam Gallinule, which is an endangered species, may inhabit reaches of the Lonfit and Pago where there are wetlands. These frequent transient wetlands.
- o Black Francolans (grauss) may be found in the area and may be hunted.
- o Bufo Morinus are the toads at the dump. The snails are African and native land snails.
- o Pigs and deer may be found in the vicinity of the landfill and may be hunted.

- o The landfill may drain into the Agana swamp to the west, probably by subterranean flow. This is an important watershed. People raise Taro in the swamp.

Gary Cami and Rob Myers:

Leads

- o Check the Ugam River EIA, it includes the Pago River. Aquatic wildlife:
- o There are no established shellfish beds in Pago Bay.
- o There are some lobster, octopus, and clams and the fish tend to resident rather than transient.
- o Information on river fish is very limited.
- o There are Mangrove crabs along the river.

Paul Liebendorfer:

Water Supply:

The USGS has logs of the neighboring school well and it may be in the limestone.

- o The school well varies between 90 and 100 feet MSL.
- o There are very few private wells on the island because they are too expensive. But, there may be some company wells.
- o Most irrigation water comes from wells in the northern limestone. The military maintains a reservior, Fenci Valley, for military and government use. Otherwise there is little surface water use as a water supply.
- o Reservoir use: 3 million gallons/day. Municipal treatment plant produces 10 million gallons/day.
- o All analyses of well water to date have met drinking water standards.
- o Typical wells in the limestone produce 200gal/min.
- ? o Vertical movement in aquifer is typically 800ft/day. Horizontal movement is 200ft/day.
- o PUAG operates the wells.

Distribution System::

- o Water is chlorinated at each well before being pumped into system.
- o System is interconnected throughout island but a greater percentage of the water from the A-series (near the landfill) goes to the subsystem feeding Agana.
- o Note that the subunits in the supply system mark actual hydrogeologic units and are not political divisions.
- o There is a 50% water loss in the system, probably due to leaks and theft.

- Principal use is domestic in the Agana subsystem. There is very little irrigation in the south. Agana subsystem serves approximately 20,000 (between 15 and 30% of the population).
- Total Agana production is 6million gallons/day. The total system is 23 million gallons/day.
- Total population of the island is 120,000.

Contacts:
- John Davidson (PUAC) 646-8891 ext.272

Survey Observations:
- Nearest residents to site are one half mile away toward the school.
- Other schools and churches are nearby as well.
- Many of the residences are simply metal shacks off dirt roads cut through the jungle. There are unlikely utilities to these places so it is unclear where they get their water.
- At the end of one residential road by an elementary school, there is a dirt road through the jungle that winds for a half mile to a meadow with shack houses and cows and access to the Lonfit. Otherwise, access to the Lonfit is restricted by dense jungle.
- The landfill is surrounded on 2 sides by uplands but the valley of the Lonfit River collects runoff from the site. However, it is not clear that all of the runoff ends up in the Lonfit.
- Pago Bay contains a coral reef. There is a beach park on the shore, which was being cleaned by volunteers from the naval base. Several houses have also been built along the shore.

John Davidson:

Water Supply Wells:
- There are 28 A-series wells.
- However, some were shut down because of high chlorine content.
- Each well yields 150 to 230gal/min.
- The wells along route 4 serve Sinajana, Agana Heights and the Dairy Road area. Some of the water from this area is also supplied to Barigada.

Treatment:
- Water is chlorinated and fluoridated at the wells. Otherwise it is not treated
- In this area, the water system is entirely closed. Water is carried through ductile and cast iron pipes. Some of the pipes are galvanized. Newer pipes are PVC (although the location of the PVC on the system is unclear).
- Wells A-26 and A-27 are drilled into deeper "dirty" limestone that underlies the newer limestone encountered in the other wells. These two wells go lower because they are located in a low area. The dirty limestone is also encountered on the other side of the system, closer to Ordot and may represent an ancient channel. Wells A-26 and A-27 were closed for chloride content.
- Water use is almost exclusively residential.

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